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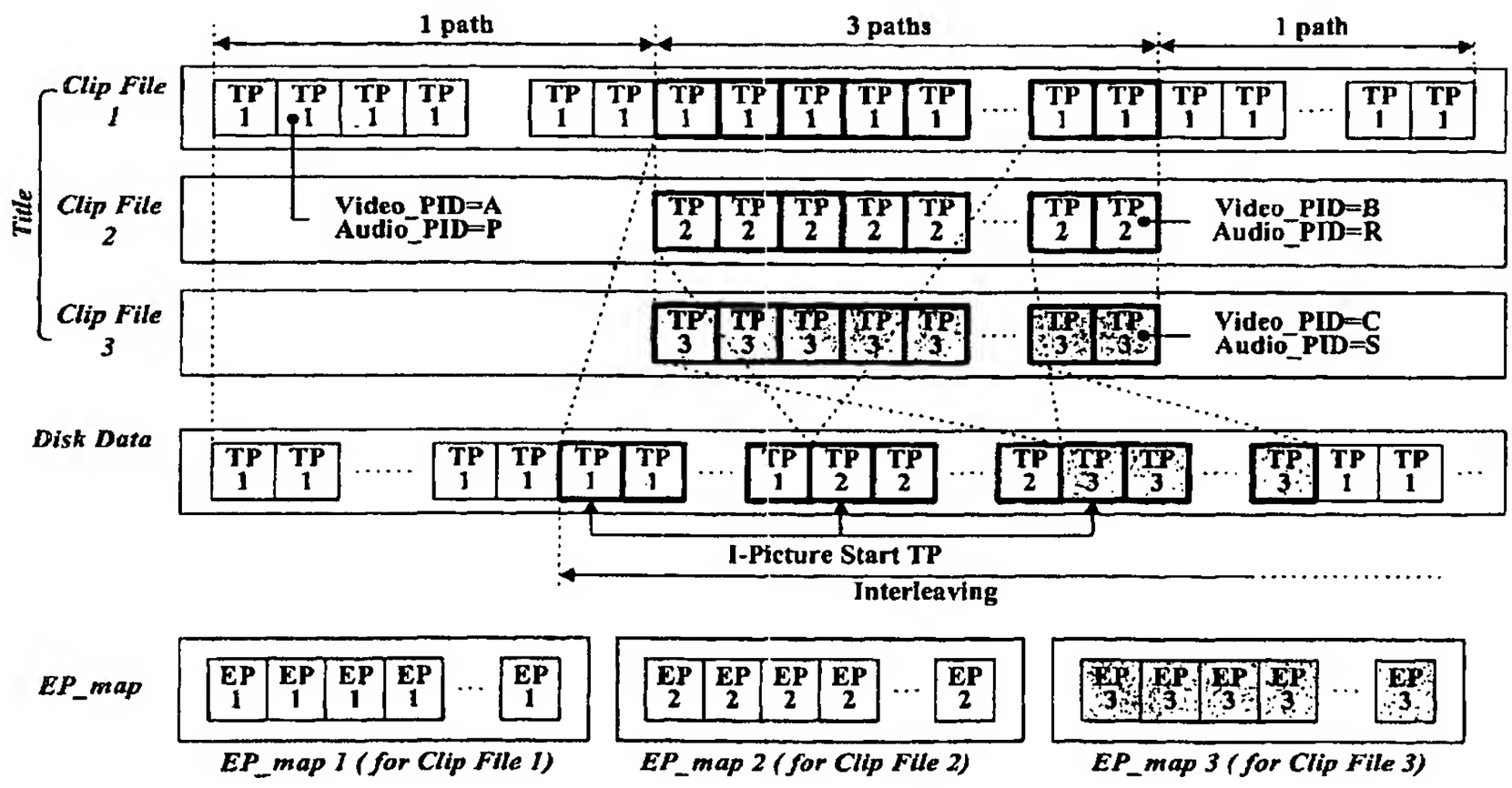
(54) **Title:** RECORDING MEDIUM HAVING DATA STRUCTURE FOR MANAGING REPRODUCTION OF MULTIPLE TITLE VIDEO DATA RECORDED THEREON AND RECORDING AND REPRODUCING METHODS AND APPARATUSES



(57) **Abstract:** A navigation area of the recording medium stores navigation management information associated with each title of video data. The navigation management information indicates at least one reproduction path for the title of video data and includes an attribute field indicating at least one attribute of the navigation management information.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

DESCRIPTION

RECORDING MEDIUM HAVING DATA STRUCTURE FOR MANAGING REPRODUCTION OF MULTIPLE TITLE VIDEO DATA RECORDED THEREON AND RECORDING AND REPRODUCING METHODS AND APPARATUSES

1. TECHNICAL FIELD

The present invention relates to a recording medium having a data structure for managing reproduction of at least multiple reproduction path video data recorded thereon as well as methods and apparatuses for reproduction and recording.

2. BACKGROUND ART

The standardization of new high-density read only and rewritable optical disks capable of recording large amounts of high-quality video and audio data has been progressing rapidly and new optical disk related products are expected to be commercially available on the market in the near future. The Blu-ray Disc Rewritable (BD-RW) is one example of these new optical disks.

Fig. 1 illustrates the file structure of the BD-RW. The file structure or data structure provides for managing the reproduction of the video and audio data recorded on the BD-RW. As shown, the data structure includes a root directory that contains at least one BDAV directory. The BDAV directory includes files such as 'info.bdav', 'menu.tidx', and 'mark.tidx', a PLAYLIST subdirectory in which playlist files (*.rpls and *.vpls) are stored, a CLIPINF subdirectory in which clip information files (*.clpi) are stored, and a STREAM subdirectory in which MPEG2-formatted A/V stream clip files (*.m2ts) corresponding to the clip information files are stored. In addition to illustrating the data structure of the optical disk, Fig. 1 represents the areas of the optical

disk. For example, the general information file info.bdav is stored in a general information area or areas on the optical disk.

Because the BD-RW data structure and disk format as illustrated in Fig. 1 is well-known and readily available, only a brief overview of the file structure will be provided in this disclosure.

As alluded to above, the STREAM directory includes MPEG2-formatted A/V stream files called clips. The STREAM directory may also include a special type of clip referred to as a bridge-clip A/V stream file. A bridge-clip is used for making seamless connection between two or more presentation intervals selected in the clips, and generally have a small data size compared to the clips. The A/V stream includes source packets of video and audio data. For example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet number, which is generally a sequentially assigned number that serves as an address for accessing the source packet. Transport packets include a packet identifier (PID). The PID identifies the sequence of transport packets to which a transport packet belongs. Each transport packet in the sequence will have the same PID.

The CLIPINF directory includes a clip information file associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence information, program information and timing information. The sequence information describes the arrival time basis (ATC) and system time basis (STC) sequences. For example, the sequence information indicates, among other things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and the PID of the transport packets in each sequence. A sequence of source packets in which the contents of a program is constant is called a program sequence. The program information indicates,

among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

The timing information is referred to as characteristic point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number).

The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of editing/assembling clips for playback. A playlist file is a collection of playing intervals in the clips. Each playing interval is referred to as a playitem. The playlist file, among other things, identifies each playitem forming the playlist, and each playitem, among other things, is a pair of IN-point and OUT-point that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies playitems, each playitem points to a clip or portion thereof and identifies the clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

A playlist directory may include real playlists (*.rpls) and virtual playlists (*.vpls). A real playlist can only use clips and not bridge-clips. Namely, the real playlist is considered as referring to parts of clips, and therefore, conceptually considered equivalent in disk space to the referred to parts of the clips. A virtual playlist can use both clips and bridge-clips, and therefore, the conceptual considerations of a real playlist do not exist with virtual playlists.

The info.bdav file is a general information file that provides general information for managing the reproduction of the A/V stream recorded on the optical disk. More specifically, the info.bdav file includes, among other things, a table of playlists

that identifies the files names of the playlist in the PLAYLIST directory of the same BDAV directory.

The menu.tidx, menu.tdt1 and menu.tdt2 files store information related to menu thumbnails. The mark.tidx, mark.tdt1 and mark.tdt2 files store information that relates to mark thumbnails. Because these files are not particularly relevant to the present invention, they will not be discussed further.

The standardization for high-density read-only optical disks such as the Blu-ray ROM (BD-ROM) is still under way. An effective data structure for managing reproduction of video and audio data recorded on the high-density read-only optical disk such as a BD-ROM is not yet available.

3. DISCLOSURE OF INVENTION

The recording medium according to the present invention includes a navigation area storing navigation control information for managing the reproduction of at least video data from the recording medium.

According to one exemplary embodiment of the present invention, the navigation area stores at least one navigation control object that includes an attribute field, a navigation item number field and at least one navigation item. The attribute field indicates, in one exemplary embodiment, a type of the navigation control object The navigation item number field indicates the number of navigation items in the navigation control object. Each navigation item provides navigation control information.

In one exemplary embodiment, the navigation control information indicates at least one playlist to reproduce. In another exemplary embodiment, the navigation control object is associated with a single title of video data. In a further exemplary embodiment, at least one playlist is stored in a playlist area of the recording medium. Each playlist identifies at least one playitem, and each playitem identifies at least one clip of video

data.

According to another exemplary embodiment of the present invention, the navigation area stores at least one navigation control object that includes an attribute field indicating at least one attribute of the navigation control object and a navigation direction number field indicating a number of navigation directions. Also, each navigation control object includes at least one navigation direction.

In one exemplary embodiment, the navigation direction indicates a playlist to reproduce. In another exemplary embodiment, the navigation control object is associated with a single title of video data. In a further exemplary embodiment, at least one playlist is stored in a playlist area of the recording medium. Each playlist identifies at least one playitem, and each playitem identifies at least one clip of video data.

The present invention further provides apparatuses and methods for recording and reproducing the data structure according to the present invention.

4. BRIEF DESCRIPTION OF DRAWINGS

The above features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 illustrates the prior art file or data structure of a rewritable optical disk according to the Blu-ray Disc Rewritable (BD-RW) standard;

Fig. 2 illustrates an exemplary embodiment of a recording medium file or data structure according to the present invention;

Fig. 3 illustrates an example of a recording medium having the data structure of Fig. 2 stored thereon;

Fig. 4A illustrate a first detailed embodiment of the clip files, disk data and EP map for use in the data structure according

to Fig. 2;

Fig. 4B illustrates the time alignment that exists between the EP maps for the different clip files;

Figs. 5 and 6 illustrate first and second embodiments of the data structure for reproduction path management information for use in the data structure according to Fig. 2;

Fig. 7 illustrates a schematic diagram of an embodiment of an optical disk recording and reproduction apparatus of the present invention; and

Fig. 8 illustrates a second detailed embodiment of the clip files, disk data and EP map for use in the data structure according to Fig. 2;

Fig. 9 illustrates another exemplary embodiment of a recording medium file or data structure according to the present invention;

Fig. 10 illustrates an example of a recording medium having the data structure of Fig. 9 stored thereon;

Fig. 11 illustrates an embodiment of the data structure for navigation control for use with the data structure of Fig. 9;

Figs. 12-14 illustrate graphical representations of different methods of structuring navigation control using the data structure of Fig. 11;

Fig. 15 illustrates another embodiment of the data structure for navigation control for use with the data structure of Fig. 9; and

Fig. 16 illustrates a graphical representation of a method of structuring navigation control using the data structure of Fig. 15.

5. MODES FOR CARRYING OUT THE INVENTION

In order that the invention may be fully understood, preferred embodiments thereof will now be described with reference to the accompanying drawings.

A high-density optical disk, for example, a Blu-Ray ROM (BD-ROM) in accordance with the invention may have a file or data structure for managing reproduction of video and audio data as shown in Fig. 2. Many aspects of the data structure according to the present invention shown in Fig. 2 are similar to that of the BD-RW standard discussed with respect to Fig 1. As such these aspects will not be described in great detail.

As shown in Fig. 2, the root directory contains at least one DVP directory. The DVP directory includes a general information file info.dvp, menu files menu.tidx, menu.tdt1 among others, a PLAYLIST directory in which playlist files (e.g., real (*.rpls) and virtual (*.vpls)) are stored, a CLIPINF directory in which clip information files (*.clpi) are stored, and a STREAM directory in which MPEG2-formatted A/V stream clip files (*.m2ts), corresponding to the clip information files, are stored.

The STREAM directory includes MPEG2-formatted A/V stream files called clips. The STREAM directory may also include a special type of clip referred to as a bridge-clip A/V stream file. A bridge-clip is used for making seamless connection between two or more presentation intervals selected in the clips, and generally have a small data size compared to the clips. The A/V stream includes source packets of video and audio data. For example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet number, which is generally a sequentially assigned number that serves as an address for accessing the source packet. Transport packets include a packet identifier (PID). The PID identifies the sequence of transport packets to which a transport packet belongs. Each transport packet in the sequence will have the same PID.

The CLIPINF directory includes a clip information file associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence information, program information and timing

information. The sequence information describes the arrival time basis (ATC) and system time basis (STC) sequences. For example, the sequence information indicates, among other things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and the PID of the transport packets in each sequence. A sequence of source packets in which the contents of a program is constant is called a program sequence. The program information indicates, among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

The timing information is referred to as characteristic point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number).

The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of editing/assembling clips for playback. A playlist file is a collection of playing intervals in the clips. Each playing interval is referred to as a playitem. The playlist file, among other things, identifies each playitem forming the playlist, and each playitem, among other things, is a pair of IN-point and OUT-point that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies playitems, each playitem points to a clip or portion thereof and identifies the clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

A playlist directory may include real playlists (*.rpls) and virtual playlists (*.vpls). A real playlist can only use clips and not bridge-clips. Namely, the real playlist is considered as referring to parts of clips, and therefore, conceptually

considered equivalent in disk space to the referred to parts of the clips. A virtual playlist can use both clips and bridge-clips, and therefore, the conceptual considerations of a real playlist do not exist with virtual playlists.

The info.dvp file is a general information file that provides general information for managing the reproduction of the A/V streams recorded on the optical disk. More specifically, the info.dvp file includes, among other things, a table of playlists that identifies the file names of the playlists in the PLAYLIST directory. The info.dvp file will be discussed in greater detail below with respect to the embodiments of the present invention.

In addition to illustrating the data structure of the recording medium according to an embodiment of the present invention, Fig. 2 represents the areas of the recording medium. For example, the general information file is recorded in one or more general information areas, the playlist directory is recorded in one or more playlist directory areas, each playlist in a playlist directory is recorded in one or more playlist areas of the recording medium, etc. Fig. 3 illustrates an example of a recording medium having the data structure of Fig. 2 stored thereon. As shown, the recording medium includes a file system information area, a data base area and an A/V stream area. The data base area includes a general information file and playlist information area and a clip information area. The general information file and playlist information area have the general information file recorded in a general information file area thereof, and the PLAYLIST directory and playlist files recorded in a playlist information area thereof. The clip information area has the CLIPINFO directory and associated clip information files recorded therein. The A/V stream area has the A/V streams for the various titles recorded therein.

Video and audio data are typically organized as individual titles; for example, different movies represented by the video and audio data are organized as different titles. Furthermore, a title

may be organized into individual chapters in much the same way a book is often organized into chapters.

Because of the large storage capacity of the newer, high-density recording media such as BD-ROM optical disks, different titles, various versions of a title or portions of a title may be recorded, and therefore, reproduced from the recording media. For example, video data representing different camera angles may be recorded on the recording medium. As another example, versions of title or portions thereof associated with different languages may be recorded on the recording medium. As a still further example, a director's version and a theatrical version of a title may be recorded on the recording medium. Or, an adult version, young adult version and young child version (i.e., different parental control versions) of a title or portions of a title may be recorded on the recording medium. Each version represents a different reproduction path, and the video data in these instances is referred to as multiple reproduction path video data. It will be appreciated that the above examples of multiple reproduction path video data are not limiting, and the present invention is applicable to any type or combination of types of multiple reproduction path video data. As will be described in detail below with respect to embodiments of the present invention, the data structures according to the present invention include path management information and/or navigation information for managing reproduction of multiple reproduction path video data recorded on the recording medium.

A multiple reproduction path data stream, for instance, a multi-story, a multi-parental-level, or a multi-angle data stream recorded as a title in a physical data recording area of a recording medium (e.g., a BD-ROM) may be managed as a plurality of clip files. For example, clip files 1-3 shown in FIG. 4A correspond to a title and the A/V streams recorded in the clip files are in the form of MPEG2-formatted transport packets (TPs).

The TPs of the multi-path data stream contain packet IDs (PIDs) unique to each of the paths (e.g., different angles) for identifying the path. The TPs (TP1) of clip file 1 corresponding to path 1 include the information that Video_PID=A and Audio_PID=P and the TPs (TP2) of clip file 2 corresponding to path 2 include the information that Video_PID=B and Audio_PID=R. Likewise, the TPs (TP3) of clip file 3 corresponding to path 3 include the information that Video_PID=C and Audio_PID=S.

The TPs of the clip files 1, 2, and 3 corresponding to paths 1, 2, and 3 respectively are recorded in the AV stream area within the physical data recording area of, for example, the BD-ROM in an interleaved manner. The TPs for the multiple reproduction paths are interleaved on a PID basis as interleave blocks, each of which contains at least one I-picture. And, the first transport packet of each interleave block is the first transport packet of an I-picture.

Clip information files 1, 2, and 3 corresponding to clip files 1, 2, and 3, respectively include search information for selectively accessing TPs of each reproduction path. For example, as shown in Fig. 4A, each clip information file includes one or more entry point (EP) maps containing the presentation time stamps (PTSs) mapping to source packet numbers (SPNs) of the TPs in an associated clip file. In one exemplary embodiment, a one-to-one relationship exists between the EP maps and the number of paths included in the multiple reproduction path data stream. In the example of FIG. 4A, three EP maps 1, 2, 3 corresponding to the clip files 1, 2, and 3, respectively, are created and recorded in the corresponding clip information files 1, 2, and 3.

Fig. 4B illustrates the time alignment that exists between the EP maps for the different clip files. As discussed, an EP map maps the presentation time stamp information such as indicated in a playitem to a source packet. More particularly, the presentation time stamp is mapped to the address or identifier of the source

packet. The address or identifier is the source packet number (SPN). Fig. 4B further shows the source packets by source packet number along the presentation time stamp axis for each clip file 1, 2, and 3. As shown, source packets in each of the EP maps 1, 2, and 3 have the same presentation time stamps. For example, source packet x1 from the first clip file 1, source packet y1 from the second clip file 2 and source packet z1 from the third clip file 3 have the same presentation time stamp T1. As such, the EP maps 1, 2 and 3 are time-aligned. Because of this time-alignment, seamless reproduction of video data is possible even when the reproduction path is changed during reproduction. Fig. 4B illustrates changes in reproduction path by two concentric circles. As shown, if a user decides to change the reproduction path from clip file 2 to clip file 1 during reproduction of source packet y2, then after completing reproduction of source packet y2, source packet x3 is the next source packet reproduced. Similarly if a user decides to change reproduction path (e.g., change camera angle to view) from clip file 1 to clip file 3 during reproduction of source packet x4, then after completing reproduction of source packet x4, source packet z5 is reproduced. It will be understood that the source packet numbers given in the example above are merely exemplary, and that a source packet in one clip file will not, generally, have the same source packet number as a time aligned source packet in another clip file.

Fig. 5 illustrates a portion of the general information file info.dvp according to an embodiment of the present invention. As shown, the general information file info.dvp includes an information field called 'TableOfPlaylists'. The playlist table 'TableOfPlaylists' indicates the length of the information field, and the number of playlists in the PLAYLIST directory. For each playlist, the playlist table 'TableOfPlaylists' indicates the file name 'PlayList_file_name' of the playlist (which identifies the playlist) and a path number 'Path_number'. The path number

'Path_number' provides path management information by indicating the path or paths to which the associated playlist belongs. In the embodiment of Figs. 4A-4B, one clip corresponds to each path. Accordingly, each playlist file includes one playitem, which points to the one clip associated with the same path as the playlist file. It should be understood, however, that the present invention is not limited to this structure.

In another exemplary embodiment of the present invention, the playlist table 'TableOfPlaylists' does not include path management information. In this embodiment, illustrated in Fig. 6, the path management information is provided in the playlist files. As shown, each playlist file indicates a length of the file, and the number of playitems 'number_of_PlayItems' forming the playlist. For each playitem, a playitem information field is provided in the playlist file. Here, each playitem is identified by the number of the playitem. As shown in Fig. 6, the playitem information field includes, in part, an indication of the field's length and a path number 'Path_number'. The path number 'Path_number' provides the path management information by indicating the path to which the associated playitem belongs.

Fig. 7 illustrates a schematic diagram of an embodiment of an optical disk recording and reproducing apparatus according to the present invention. As shown, an AV encoder 9 receives and encodes audio and video data. The AV encoder 9 outputs the encoded audio and video data along with coding information and stream attribute information. A multiplexer 8 multiplexes the encoded audio and video data based on the coding information and stream attribute information to create, for example, an MPEG-2 transport stream. A source packetizer 7 packetizes the transport packets from the multiplexer 8 into source packets in accordance with the audio/video format of the optical disk. As shown in Fig. 7, the operations of the AV encoder 9, the multiplexer 8 and the source packetizer 7 are controlled by a controller 10. The controller 10

receives user input on the recording operation, and provides control information to AV encoder 9, multiplexer 8 and the source packetizer 7. For example, the controller 10 instructs the AV encoder 9 on the type of encoding to perform, instructs the multiplexer 8 on the transport stream to create, and instructs the source packetizer 7 on the source packet format. The controller 10 further controls a drive 3 to record the output from the source packetizer 7 on the optical disk.

The controller 10 also creates the navigation and management information for managing reproduction of the audio/video data being recorded on the optical disk. For example, based on information received via the user interface (e.g., instruction set saved on disk, provided over an intranet or internet by a computer system, etc.) the controller 10 controls the drive 3 to record the data structure of Figs. 2, 4 and 5 or 6 on the optical disk.

During reproduction, the controller 10 controls the drive 3 to reproduce this data structure. Based on the information contained therein, as well as user input received over the user interface (e.g., control buttons on the recording and reproducing apparatus or a remote associated with the apparatus), the controller 10 controls the drive 3 to reproduce the audio/video source packets from the optical disk. For example, the user input may specify a path to reproduce. This user input may be specified, for example, via a menu based graphical user interface preprogrammed into the controller 10. Using the user input and the path management information reproduced from the optical disk, the controller 10 controls the reproduction of the specified path.

For example, to select a particular path, the path numbers for each playlist are examined by the controller 10 to determine the number of reproduction paths, and the user is requested which path to reproduce. The path management information may be augmented to provide more meaningful information regarding the reproduction path to reproduce. During reproduction, the EP map for the selected

path is accessed to perform reproduction. And, as discussed above, if the user changes the reproduction path during reproduction, a seamless change takes place by using the EP map of the new reproduction path that is aligned in time with the EP map of the old reproduction path.

The reproduced source packets are received by a source depacketizer 4 and converted into a data stream (e.g., an MPEG-2 transport packet stream). A demultiplexer 5 demultiplexes the data stream into encoded video and audio data. An AV decoder 6 decodes the encoded video and audio data to produce the original audio and video data that was feed to the AV encoder 9. During reproduction, the controller 10 controls the operation of the source depacketizer 4, demultiplexer 5 and AV decoder 6. The controller 10 receives user input on the reproducing operation, and provides control information to AV decoder 6, demultiplexer 5 and the source packetizer 4. For example, the controller 10 instructs the AV decoder 9 on the type of decoding to perform, instructs the demultiplexer 5 on the transport stream to demultiplex, and instructs the source depacketizer 4 on the source packet format.

While Fig. 7 has been described as a recording and reproducing apparatus, it will be understood that only a recording or only a reproducing apparatus may be provided using those portions of Fig. 7 providing the recording or reproducing function.

Fig. 8 illustrates a second detailed embodiment of the clip files, disk data and EP map for use in the data structure according to Fig. 2. As explained before, a multi-path data stream recorded in a physical data recording area, for example, of the BD-ROM may be managed as a plurality of clip files. For example, clip files 1-3 shown in FIG. 8 correspond to a title and the A/V streams recorded in the clip files are in the form of MPEG2-formatted transport packets (TPs).

The TPs (TP1) of clip file 1 corresponding to Path 1 include the information that Video_PID=A and Audio_PID=P and the TPs (TP2)

of clip file 2 corresponding to Path 2 include the information that Video_PID=B and Audio_PID=R. Likewise, the TPs (TP3) of clip file 3 corresponding to Path 3 include the information that Video_PID=C and Audio_PID=S. The TPs of the clip files 1, 2, and 3 corresponding to Paths 1, 2, and 3 respectively are recorded in the AV stream area within the physical data recording area of the recording medium (e.g., BD-ROM) in an interleaved manner. As mentioned before, the different paths may, in one exemplary embodiment be different camera angles.

The TPs for multiple reproduction paths are interleaved as interleave blocks each of which contains at least one I-picture. And the first transport packet of each interleave block is the first transport packet of an I-picture.

The path management information for playback control of the single-path and multi-path A/V streams recorded as a single title in the physical data recording area of the BD-ROM may be recorded in a clip information file corresponding to the clip files, as depicted in FIG. 8.

For example, the path management information is recorded and managed as path sequence information in a clip information file corresponding to the clip files 1, 2, and 3. The path sequence information includes the path sequence numbers (Path_Sequence Numbers) corresponding to the recording segments, for example, recording segments 1, 2, and 3 and video/audio PIDs (Video_PIDs and Audio_PIDs).

In more detail, Path_Sequence #1, corresponding to a first recording segment, includes the information that 'Video_PID=A' and 'Audio_PID=P', which indicates that this recording segment only includes video data for the first reproduction path. Path_Sequence #2, corresponding to the second recording segment, includes the information that 'Video_PID =A,B,C' and 'Audio_PID=P,R,S', which indicates that this segment of video data includes video data for the first, the second, and the third

reproduction paths. Path_Sequence #3, corresponding to a third recording segment, includes the information that 'Video_PID =C' and 'Audio_PID=S', which indicates that the video data in this recording segment includes video data for only the third reproduction path.

Each path sequence also includes a source packet number SPN for each reproduction path in the path sequence. The SPN for a reproduction path is the first source packet for that reproduction path in that path sequence.

A path sequence may correspond to video data segment having one or more of the reproduction paths included therein. Also, the number of path sequences is not limited to three.

In addition to the path sequence information, Fig. 8 shows that the clip information files for the clip files 1, 2, and 3, provide the same search information for selectively accessing TPs of each path recorded in the first through third segments. For example, the same EP map is provided by clip information files. When the EP map information recorded in the clip information files is managed as a single EP map, the PTSs and SPNs of TPs of the different reproduction paths are recorded in the EP map by interleaving in the same order that the TPs of the different reproduction paths are recorded.

Alternatively, as shown with respect to Figs. 4A and 4B, a one-to-one correspondence may exist between EP maps and reproduction paths. In the case of Fig. 8, three EP maps (EP_map 1, 2, 3) corresponding to the groups of TPs of paths 1, 2, 3 respectively would be created and recorded in the clip information file.

As will be readily apparent, the recording and reproducing apparatus of Fig 7 may operate in the same manner with respect to the embodiment of Fig. 8 as was described above with respect to Figs. 4A and 4B. However, it will be appreciated that other methods of reproduction are also possible and the present invention is not

limited to this one example. For instance, path management information in the form of the path sequence information in the clip information files may be reproduced and used to manage the reproduction of multiple reproduction path video data. Here, the PIDs in each path sequence are examined to determine the number of reproduction paths. The user is then requested to select a path. If a single EP map is provided, the controller 10 uses the EP map and the PID of the selected path to reproduce the appropriate clip file for the selected reproduction path. If an EP map for each reproduction path is provided, then the EP map corresponding to the selected reproduction path is used to reproduce the clip file for the selected reproduction path. And, as discussed above, if the user changes the reproduction path during reproduction, a seamless change takes place by using the EP map of the new reproduction path that is aligned in time with the EP map of the old reproduction path.

Fig. 9 illustrates another data structure according to an embodiment of the present invention. As shown, in this embodiment, the DVP directory includes a single TITLE directory. The TITLE directory includes a general information file *.ttl for each title of video data recorded on the recording medium. For example, a director's cut title and an associated theatrical title may be provided on the recording medium and a general information file 'info.ttl' would be provided for each title. The general information files *.ttl are the same as the general information file info.dvp discussed above with respect to Fig. 2, except for certain additional information fields discussed in detail below. As further shown in Fig. 9, the DVP directory includes a single PLAYLIST directory, CLIPINFO directory and STREAM directory. These directories contain the same information and files as described above with respect to Fig. 2, but do so for all of the titles. As with Fig. 2, Fig. 9 represents areas of the recording medium, and Fig. 10 illustrates an exemplary embodiment of the recording medium

including these areas. Fig. 10 is the same as Fig. 3 discussed above, except that the general information file and playlist information area includes a navigation area storing navigation control information as discussed in detail below. While Fig 10 illustrates one navigation area, it should be understood that more than navigation area may be present.

Fig. 11 illustrates a portion of a general information file 'info.ttl' for a title according to an embodiment of the present invention in greater detail. As shown, the general information file 'info.ttl' includes an navigation control information or object field called 'PlayList Sequencer'. The playlist sequencer 'PlayList Sequencer' indicates the length of the information field, a type of the playlist sequencer, and the number of included playlists. The type field provides one or more attributes for the playlist sequencer. For example, a flag in the type field may indicate whether the playlist sequencer is resumable by command or user operation. As another example, a flag in the type field may indicate whether the playlist sequencer is accessible during a title search operation. It will be appreciated that numerous other possible attributes may be specified in the type field.

For each playlist, the playlist sequencer 'PlayList Sequencer' indicates the file name 'PlayList_file_name' of the playlist for playback (e.g., provides navigation directions on playback), a path number 'Path_number' of the playlist and the property of the playlist. The path number 'Path_number' also provides the path or navigation management information by indicating the path or paths to which the associated playlist belongs. The property 'Property' may indicate a particular function for a playlist to conduct.

Figs. 12-14 illustrate graphical representations of different methods of structuring navigation control using the data structure of Fig. 11. As explained before, a multi-path data stream recorded in the AV stream area of, for example, a BD-ROM

may be managed as a plurality of clip files. The plurality of clip files are associated with a plurality of playlist files that are allocated to different paths by a playlist sequencer corresponding to a single title file.

In the example of FIG. 12, the clip files 1 and 2 allocated to a single path (common path of paths m and n) are associated with the first playlist PlayList #1, the clip file 3 allocated to the path m is associated with the second playlist PlayList #2, the clip file 4 allocated to the path n is associated with the third playlist PlayList #3, and the clip file 5 allocated to a single path is associated with the fourth playlist PlayList #4.

The playlists associated with the five clip files are selected to play a particular path m or n based on path number information 'Path_number' as directed by the playlist sequencer such that the playlist sequencer provides navigation control information corresponding to a single title file. In the multi-path section, the second playlist PlayList #2 is selected in case of path m and the third playlist PlayList #3 is selected in case of path n.

In other words, if path m is chosen, the clip files 1, 2, 3, and 5 are played back sequentially through selection of the playlists 1, 2, and 4 by the playlist sequencer, and if path n is selected, the clip files 1, 2, 4, and 5 are played back through selection of the playlists 1, 3, and 4 by the playlist sequencer.

The multi-path section of the video data, namely, the A/V stream of clip files 3 and 4 may be interleaved with each other instead of being separately recorded.

Next, as will be described with respect to Fig. 13. the playlist sequencer can refer to virtual playlists that are created through user editing of clip play-back order. As explained before, a multi-path data stream recorded in an AV stream area of, for example, a BD-ROM may be managed as a plurality of clip files. The plurality of clip files are associated with a plurality of

real and/or virtual playlist files that are allocated to different paths by a playlist sequencer corresponding to a single title file.

In the example of FIG. 13, the clip files 1, 2, and 6 are allocated to a single path (common path of paths m, n, and p), the clip file 3 is allocated to the path m, the clip file 4 is allocated to the path n, and the clip file 5 is allocated to the path p. Also, the clip files 1-6 are respectively associated with three virtual playlists created by user editing.

The virtual playlists associated with the six clip files are selected to play a particular path m, n, or p by the playlist sequencer, which provides the navigation control information (e.g., navigation directions) corresponding to a single title file. Namely, the playlist sequencer provides directions on which playlist to playpack.

That is, if path m is chosen, the clip files 1, 2, 3, and 6 are played back sequentially based on the path information 'Path_number' through selection of the virtual playlist 1 by the playlist sequencer. If path n is selected, the clip files 1, 2, 4, and 6 are played back through selection of the virtual playlist 2 by the playlist sequencer, and if path p is selected, the clip files 1, 2, 5 and 6 are played back through selection of the virtual playlist 3 by the playlist sequencer.

In other words, in the multi-path section of the video data, the clip file 3 pertaining to the path m is played if the virtual playlist 1 is chosen, the clip file 4 pertaining to the path n is played if the virtual playlist 2 is selected, and the clip file 5 pertaining to the path p is played if the virtual playlist 3 is selected.

Consequently, a selection of a virtual playlist is also a selection of a particular path among a multi-path data stream in the above embodiment. However, it will be understood that this embodiment may be implemented using real playlists or a

combination of real and virtual playlists.

In this embodiment, the multi-path section, namely A/V stream of clip files 3, 4 and 5 may be interleaved each other instead of being separately recorded.

The general information file may include a single playlist sequencer as illustrated in FIG. 11. In the further example of FIG. 14, the play lists 2, 3, 4 that belong to different paths m, n, and p respectively are included in the single playlist sequencer. Alternatively, the general information file may include multiple playlist sequencers for each title. Fig. 15 illustrates the playlist sequencer according to this embodiment, wherein a playlist sequencer is provided for each reproduction path of a title.

Fig. 15 illustrates a portion of the general information file 'info.ttl' that includes one or more navigation control information fields called 'PlayList Sequencer'. Each playlist sequencer 'PlayList Sequencer' indicates the length of the information field, a type of the playlist sequencer, a path number 'Path_number' of the playlist sequencer 'PlayList Sequencer' and the number of included playlists. The type field provides one or more attributes for the playlist sequencer. For example, a flag in the type field may indicate whether the playlist sequencer is resumable by command or user operation. As another example, a flag in the type field may indicate whether the playlist sequencer is accessible during a title search operation. It will be appreciated that numerous other possible attributes may be specified in the type field.

For each playlist, the playlist sequencer 'PlayList Sequencer' indicates the file name 'PlayList_file_name' of the playlist (which identifies the playlist to playback) and the property of the playlist. The path number 'Path_number' provides the path or navigation management information by indicating the path for which the playlist sequencer 'PlayList Sequencer'

provides navigation control information. The property 'Property' may indicate a particular function for a playlist to conduct.

Fig. 16 illustrates a graphical representation of a method of structuring navigation control using the data structure of Fig. 15. There are three playlist sequencers in the example of FIG. 16. The first playlist sequencer includes the first playlist 'PlayList #1' commonly pertaining to paths m/n/p, the second playlist 'PlayList #2' pertaining to the path m, and the fifth playlist 'PlayList #5' commonly pertaining to paths m/n/p. The second playlist sequencer includes the first playlist 'PlayList #1', the third playlist 'PlayList #3' pertaining to the path n, and the fifth playlist 'PlayList #5'. The third playlist sequencer includes the first playlist 'PlayList #1', the fourth playlist 'PlayList #4' pertaining to the path p, and the fifth playlist 'PlayList #5'.

The recording and reproducing apparatus described with respect to Fig. 7 is also applicable to recording and reproducing the embodiments of the recording medium having data structures as described above with respect to Figs. 9-16. As will be appreciated, the recording and reproducing apparatus of Fig. 7 operates in the same manner as was described above with respect to Figs. 4A and 4B in recording the data structures of Figs. 9-16 on the recording medium (e.g., BD-ROM). Reproduction by the recording and reproducing apparatus of Fig. 7 is also substantially the same, except that the playlist sequencer or sequencers are reproduced, and the navigation management information provided thereby is used to control reproduction of the video data.

For example, in one embodiment, the controller 10 determines the number of reproduction paths by examining the path numbers provided for playlists in the playlist sequencer. The user is then requested which path to reproduce. The path management information may be augmented to provide the user with more meaningful information regarding the reproduction path to reproduce. The

controller 10 will then playback playlists which the playlist sequencer instructs are associated with the selected path; namely, playlists in the playlist sequencer associated with the selected path.

As another example, the controller 10 determines the number of titles recorded on the recording medium by examining the number of general information files 'info.ttl' recorded on the recording medium. The user is then requested which title to reproduce. The general information file 'info.tt' for each title may include information on the associated title, which the controller 10 may provide to the user to aid in selecting a title. The controller 10 then uses the playlist sequencer associated with the selected title to reproduce video data recorded on the recording medium. Here, the playlist sequencer for the selected title provides navigation directions on the video data to playback for the selected title by instructing which playlists to playback.

The embodiments of Figs. 11-16 of the present invention have been described as applied to the data structure of Fig. 9; however, it will be appreciated that these embodiments are also applicable to the data structure of Fig. 2.

As will be appreciated from the forgoing disclosure, the present invention provides a recording medium having a file or data structure that permits managing and/or controlling navigation of the reproduction of video data on a multiple reproduction path and/or multiple title basis. Accordingly, the present invention provides a greater level of flexibility in the reproduction of video data than previously available.

While the invention has been disclosed with respect to a limited number of embodiments, those skilled in the art, having the benefit of this disclosure, will appreciate numerous modifications and variations there from. For example, while described with respect to a Blu-ray ROM optical disk in several instances, the present invention is not limited to this standard

of optical disk or to optical disks. It is intended that all such modifications and variations fall within the spirit and scope of the invention.

CLAIMS

1. A recording medium having a data structure for managing reproduction of multiple title video data recorded on the recording medium, comprising:

a navigation area storing navigation management information associated with each title of video data, the navigation management information associated with a title indicating at least one reproduction path for the title and including an attribute field indicating at least one attribute of the navigation management information.

2. The recording medium of claim 1, further comprising:

at least one playlist area storing playlist files, each playlist file identifying at least one playitem, each playitem identifying at least one clip of the multiple title video data.

3. The recording medium of claim 2, wherein each navigation management information associated with a title identifies at least one playlist file to playback during reproduction of the title.

4. The recording medium of claim 3, wherein at least two playitems, each from a different playlist file, identify a same clip.

5. The recording medium of claim 3, wherein at least one clip represents video data common to more than one reproduction path.

6. The recording medium of claim 3, wherein at least one clip represents video data for only one reproduction path.

7. The recording medium of claim 1, wherein the multiple title video data are packets of video data.

8. The recording medium of claim 1, wherein the video data is multiple reproduction path video data.

9. The recording medium of claim 8, further comprising:

a data area having at least the video data packets recorded therein, and at least a portion of the recorded video data packets

belonging to different reproduction paths being multiplexed.

10. The recording medium of claim 1, wherein multiple title video data include video data for a director's cut title and video data for a theatrical title.

11. A method of recording a data structure for managing reproduction of at least multiple reproduction path video data on a recording medium, comprising:

recording navigation management information associated with each title of video data in at least one navigation area of the recording medium, the navigation management information associated with a title indicating at least one reproduction path for the title and including an attribute filed indicating at least one attribute of the navigation management information.

12. A method of reproducing a data structure for managing reproduction of at least multiple reproduction path video data recorded on a recording medium, comprising:

reproducing navigation management information associated with each title of video data from at least one navigation area of the recording medium, the navigation management information associated with a title indicating at least one reproduction path for the title and including an attribute filed indicating at least one attribute of the navigation management information.

13. An apparatus for recording a data structure for managing reproduction of at least multiple reproduction path video data on a recording medium, comprising:

a driver for driving an optical recording device to record data on the recording medium;

an encoder for encoding at least multiple reproduction path video data; and

a controller for controlling the driver to record the encoded multiple reproduction path video data on the recording medium, the controller for controlling the driver to record navigation management information associated with each title of video data

in at least one navigation area of the recording medium, the navigation management information associated with a title indicating at least one reproduction path for the title and including an attribute filed indicating at least one attribute of the navigation management information.

14. An apparatus for reproducing a data structure for managing reproduction of at least multiple reproduction path video data recorded on a recording medium, comprising:

a driver for driving an optical reproducing device to reproduce data recorded on the recording medium;

a controller for controlling the driver to reproduce navigation management information associated with each title of video data from at least one navigation area of the recording medium, the navigation management information associated with a title indicating at least one reproduction path for the title and including an attribute filed indicating at least one attribute of the navigation management information.

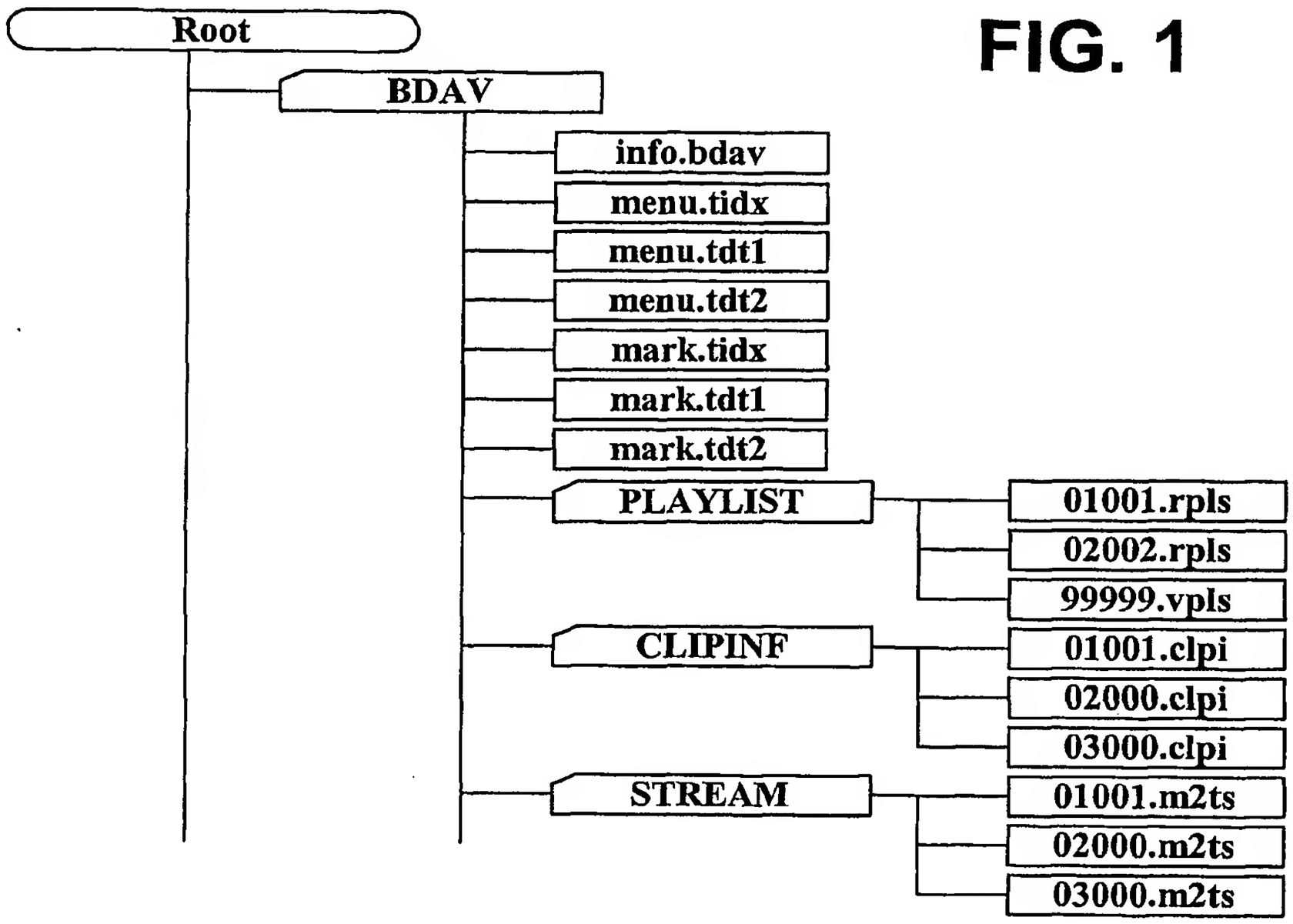

Root
BDAV
info.bdav
menu.tidx
menu.tdt1
menu.tdt2
mark.tidx
mark.tdt1
mark.tdt2
PLAYLIST
01001.rpls
02002.rpls
99999.vpls
CLIPINF
01001.clpi
02000.clpi
03000.clpi
STREAM
01001.m2ts
02000.m2ts
03000.m2ts

FIG. 1

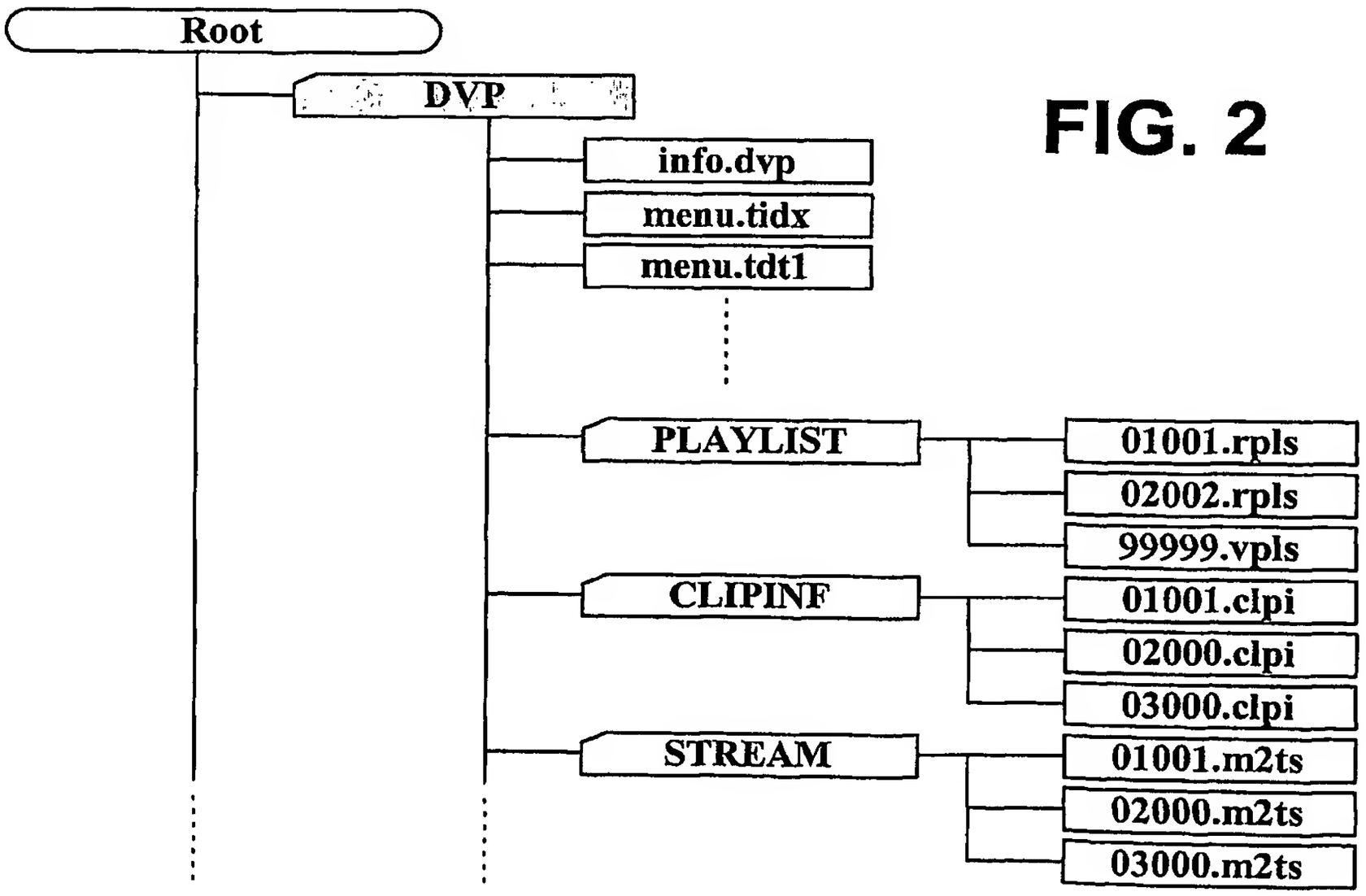

Root
DVP
info.dvp
menu.tidx
menu.tdt1
PLAYLIST
01001.rpls
02002.rpls
99999.vpls
CLIPINF
01001.clpi
02000.clpi
03000.clpi
STREAM
01001.m2ts
02000.m2ts
03000.m2ts

FIG. 2

FIG. 3

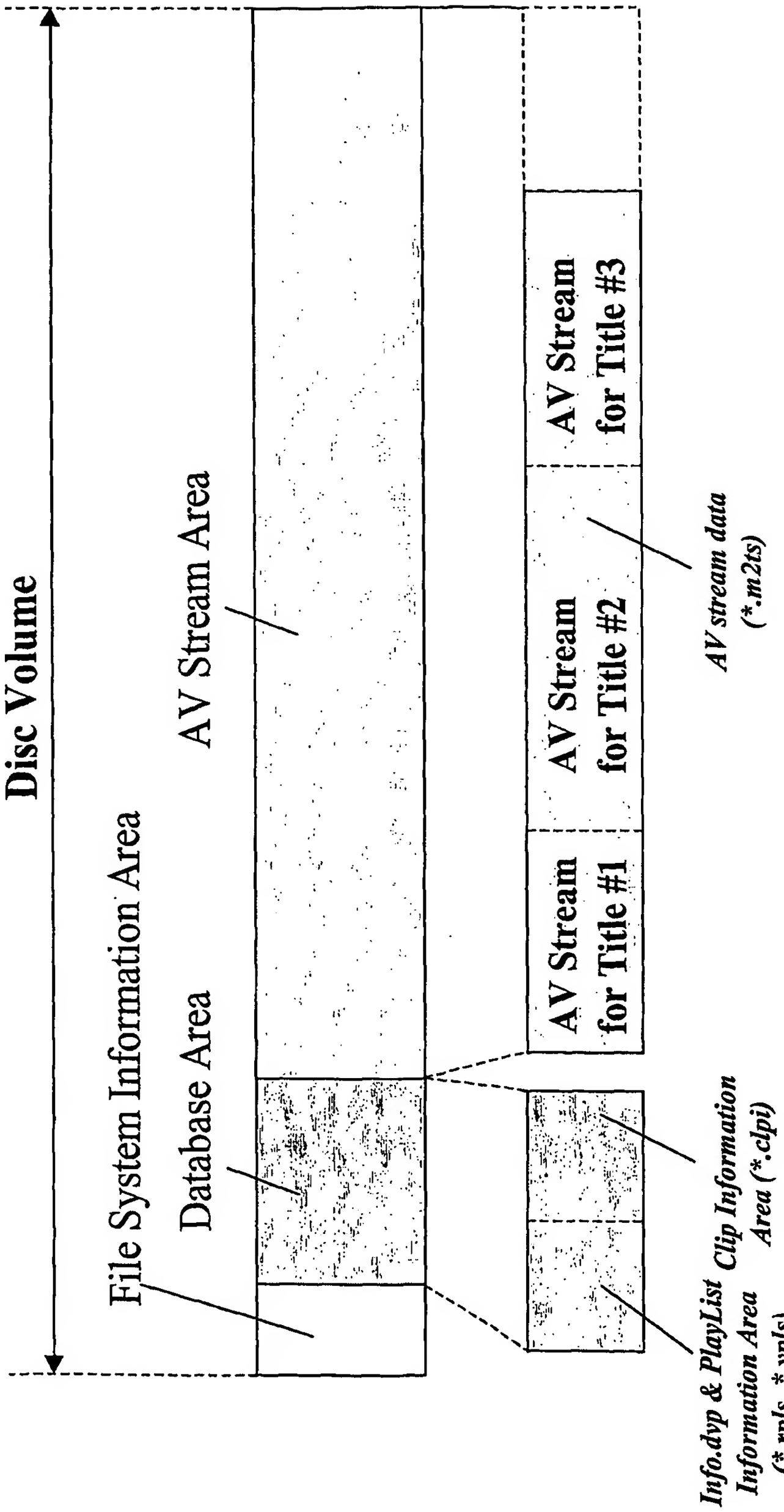

Disc Volume
File System Information Area
Database Area
AV Stream Area
AV Stream for Title #1
AV Stream for Title #2
AV Stream for Title #3
AV stream data (*.m2ts)
Info.dvp & PlayList Information Area (*.rpls, *.vpls)
Clip Information Area (*.clpi)

FIG. 4A

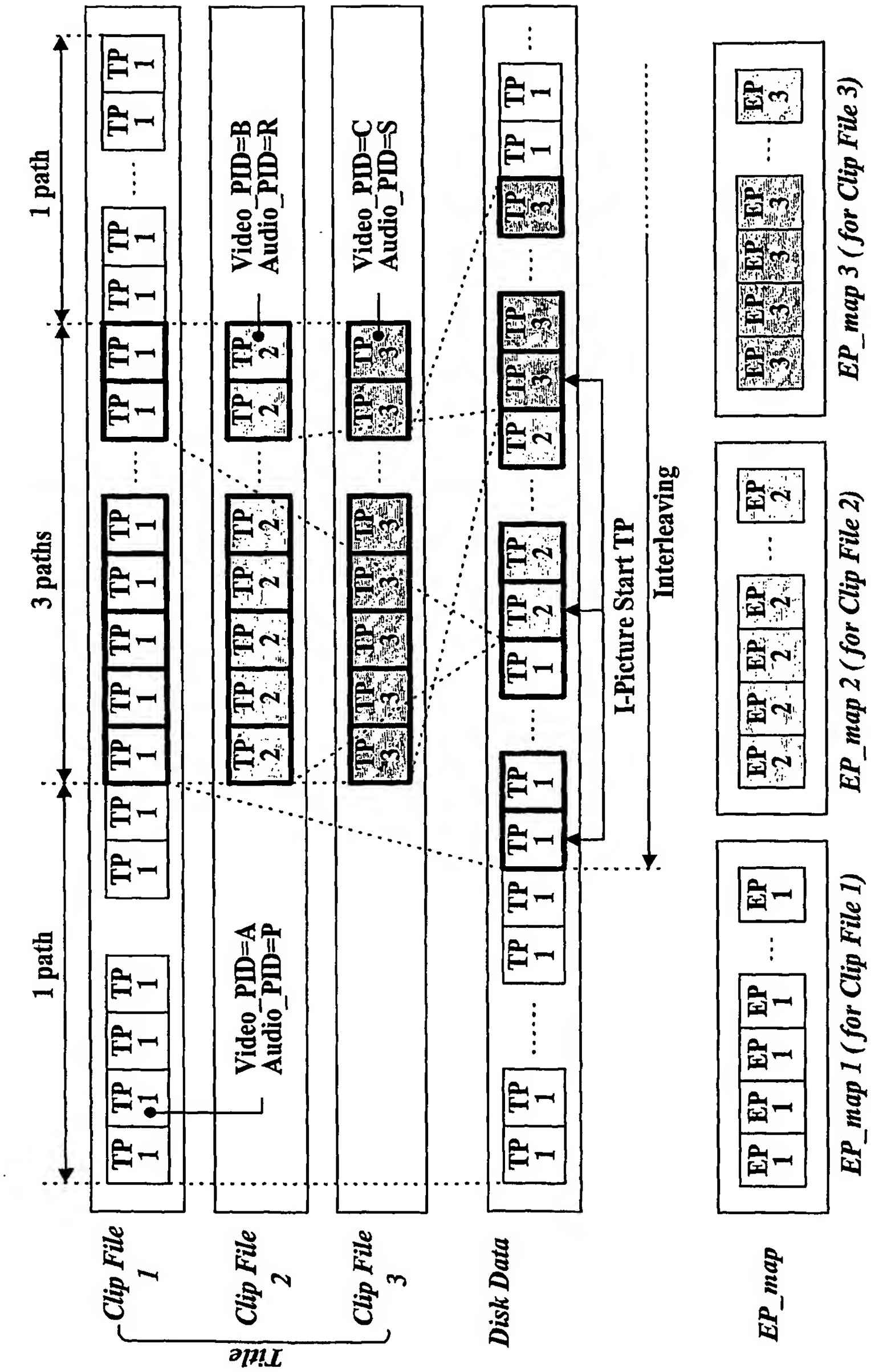

1 path
3 paths
1 path
Video_PID=B
Audio_PID=R
Video_PID=C
Audio_PID=S
Video_PID=A
Audio_PID=P
I-Picture Start TP
Interleaving
Clip File 1
Clip File 2
Clip File 3
Title
Disk Data
EP_map
EP_map 1 (for Clip File 1)
EP_map 2 (for Clip File 2)
EP_map 3 (for Clip File 3)

FIG. 4B

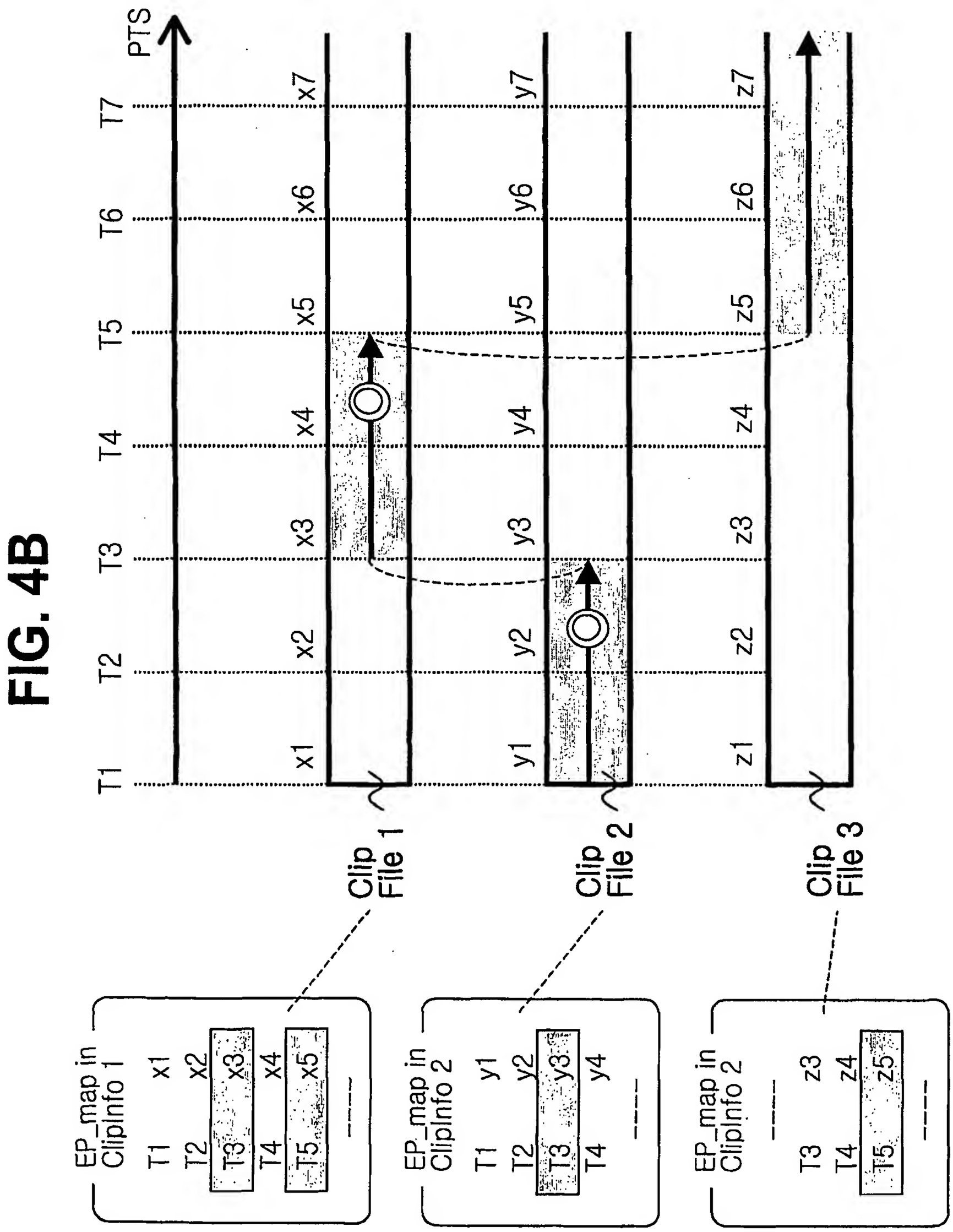

PTS
T1
T2
T3
T4
T5
T6
T7
x1
x2
x3
x4
x5
x6
x7
y1
y2
y3
y4
y5
y6
y7
z1
z2
z3
z4
z5
z6
z7
Clip File 1
Clip File 2
Clip File 3
EP_map in ClipInfo 1
T1 x1
T2 x2
T3 x3
T4 x4
T5 x5
EP_map in ClipInfo 2
T1 y1
T2 y2
T3 y3
T4 y4
EP_map in ClipInfo 2
T3 z3
T4 z4
T5 z5

FIG. 5

info.dvp - syntax

info.dvp {
version_number
TableOfPlayLists_start_address
reserved_for_future_use
⋮
TableOfPlayLists(){
length
number_of_PlayLists
for(I=0; i<number_of_PlayLists; i++){
PlayList_file_name
path_number
.....
}
}
⋮

FIG. 6

**.rpls - syntax*

xxxxx.rpls {
version_number
.....
PlayList(){
length
.....
number_of_PlayItems
for(i=0; i<number_of_Playitems; i++){
PlayItem()
⋮

PlayItem(){
length
.....
path_number
.....

FIG. 7

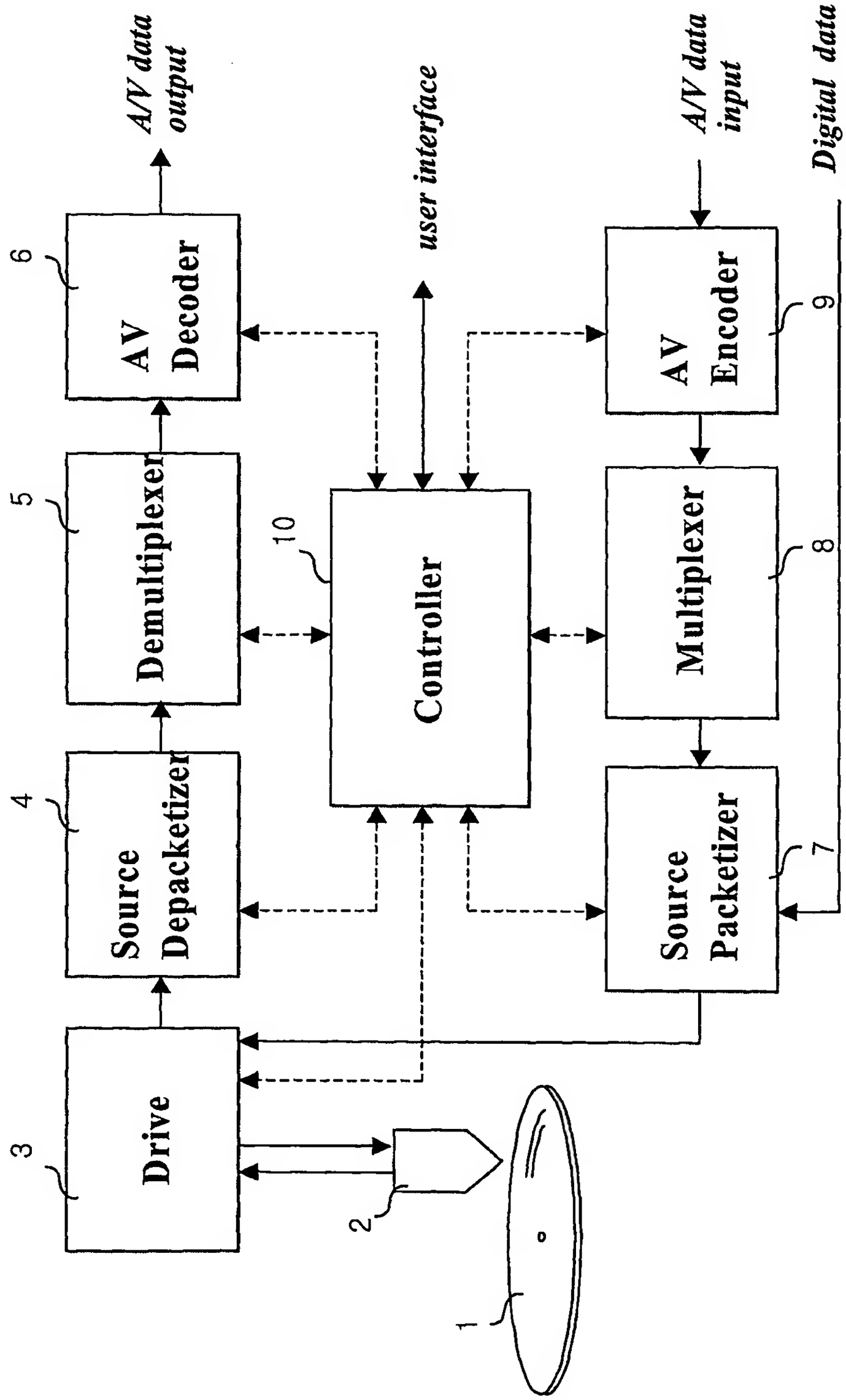

A/V data output
A/V data input
Digital data input
user interface
AV Decoder
AV Encoder
Demultiplexer
Multiplexer
Source Depacketizer
Source Packetizer
Controller
Drive
6
5
4
9
8
7
10
3
2
1

FIG. 8

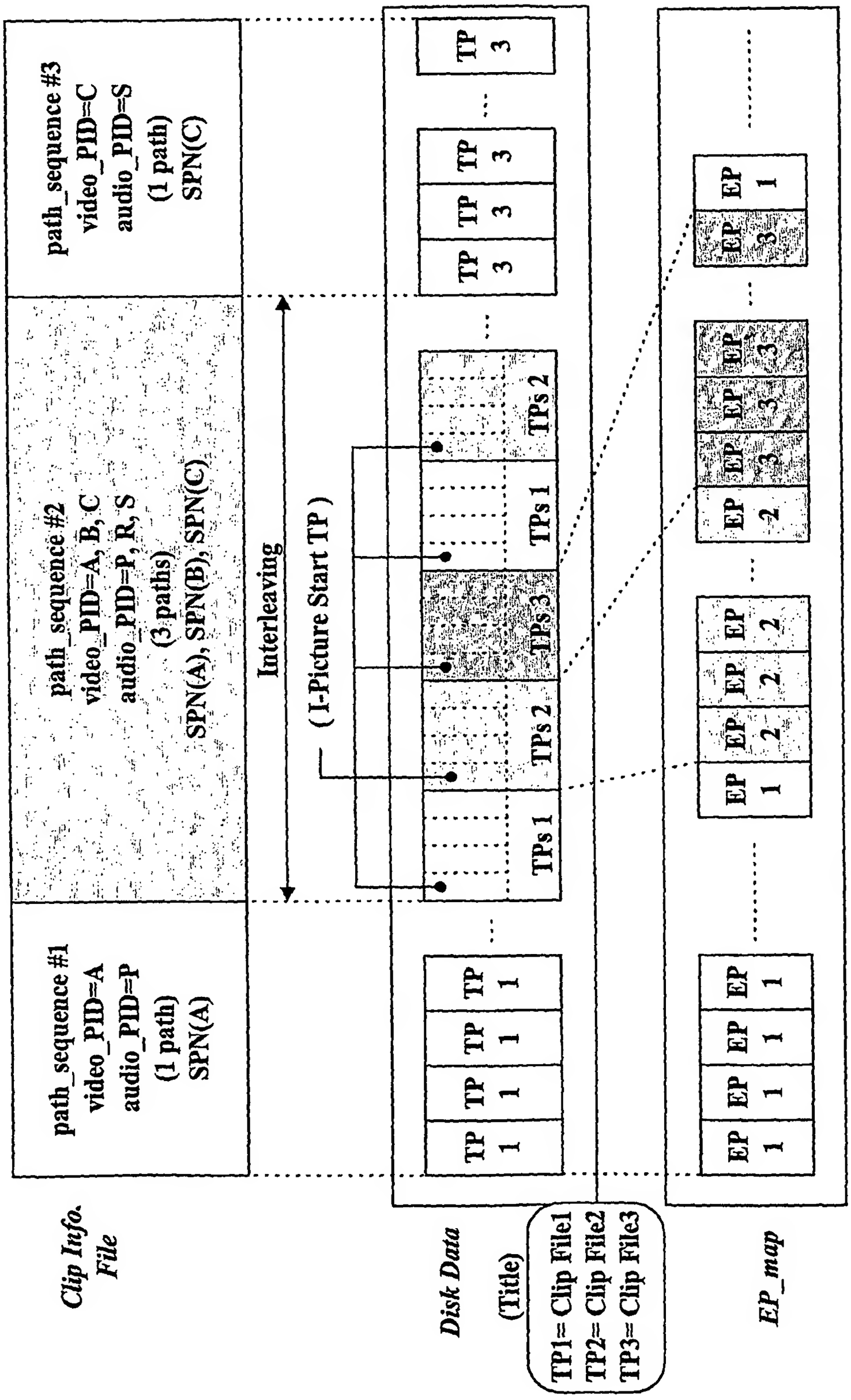

Clip Info. File
path_sequence #1
video_PID=A
audio_PID=P
(1 path)
SPN(A)
path_sequence #2
video_PID=A, B, C
audio_PID=P, R, S
(3 paths)
SPN(A), SPN(B), SPN(C)
path_sequence #3
video_PID=C
audio_PID=S
(1 path)
SPN(C)
Interleaving
(I-Picture Start TP)
Disk Data
(Title)
TP1= Clip File1
TP2= Clip File2
TP3= Clip File3
TPs 1
TPs 2
TPs 3
TP
EP
EP_map

FIG. 9

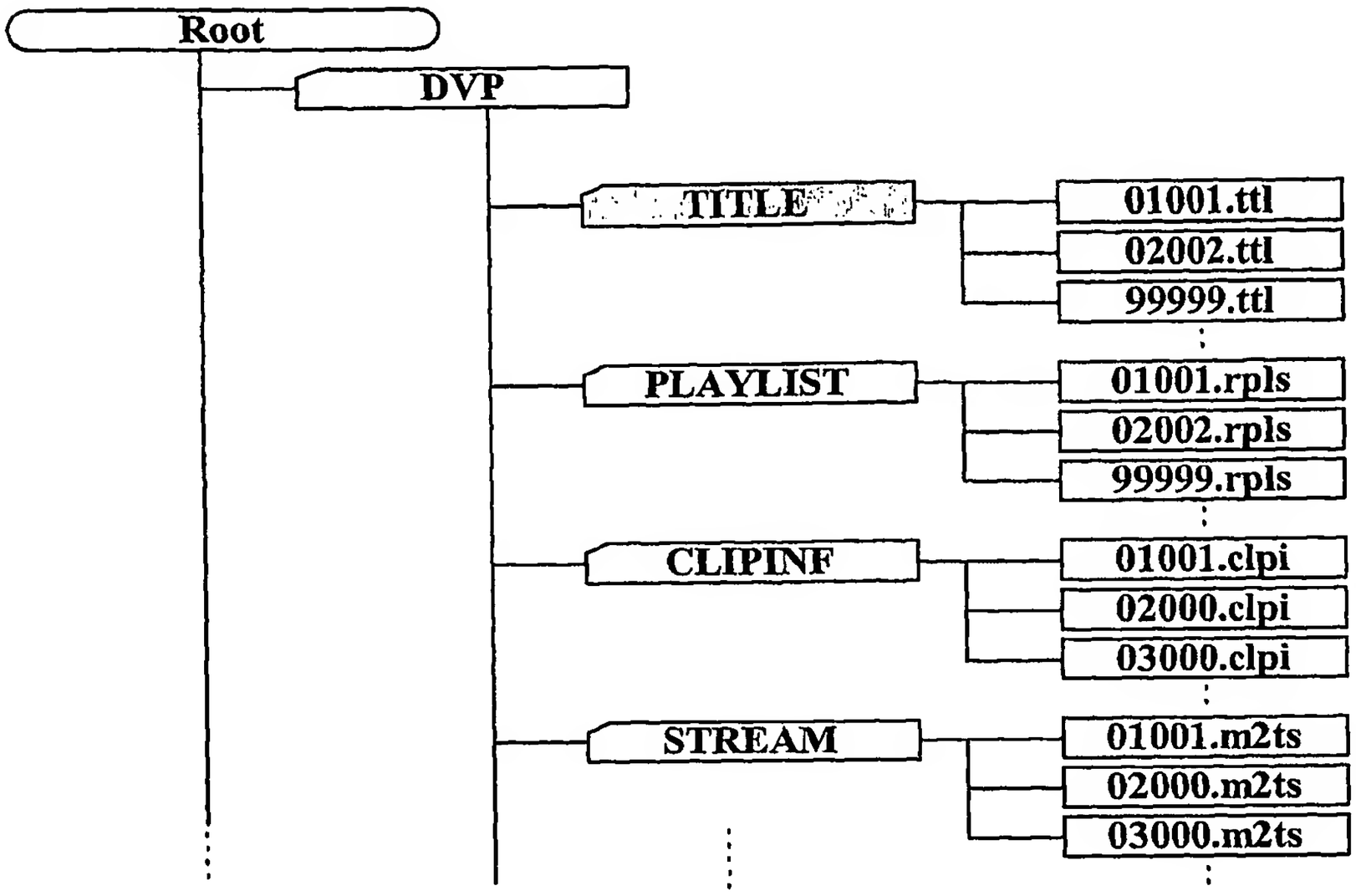

Root
DVP
TITLE
01001.ttl
02002.ttl
99999.ttl
PLAYLIST
01001.rpls
02002.rpls
99999.rpls
CLIPINF
01001.clpi
02000.clpi
03000.clpi
STREAM
01001.m2ts
02000.m2ts
03000.m2ts

FIG. 10

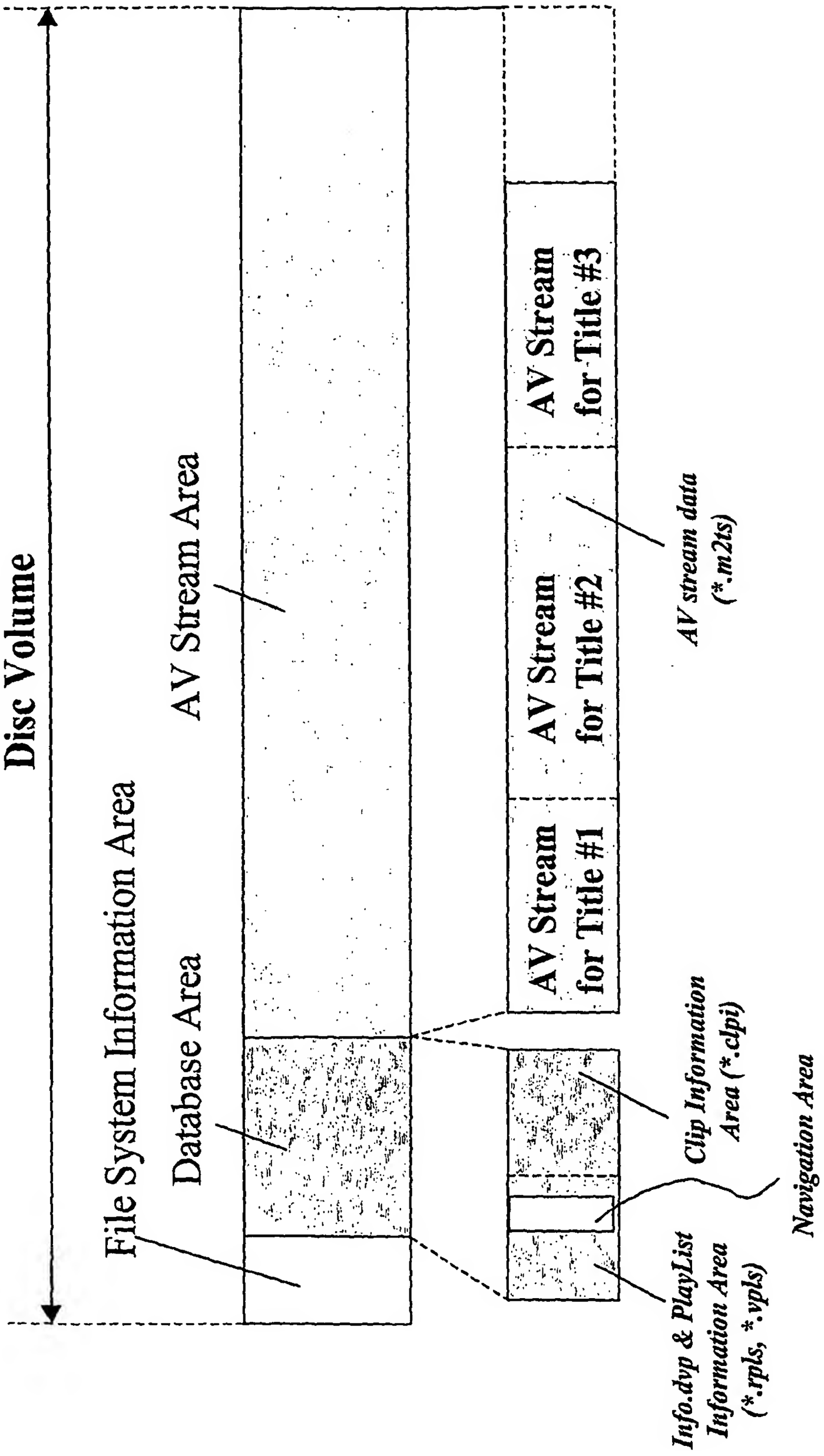

Disc Volume
File System Information Area
Database Area
AV Stream Area
AV Stream for Title #1
AV Stream for Title #2
AV Stream for Title #3
AV stream data (*.m2ts)
Clip Information Area (*.clpi)
Navigation Area
Info.dvp & PlayList Information Area (*.rpls, *.vpls)

FIG. 11

```
PlayList_Sequencer () {
        Length
        Type
        Number_of_PlayLists
        for (I=0; j<number_of_PlayLists; j++) {
                PlayList_file_name
                Path_number
                Property
        }
}
```

FIG. 12

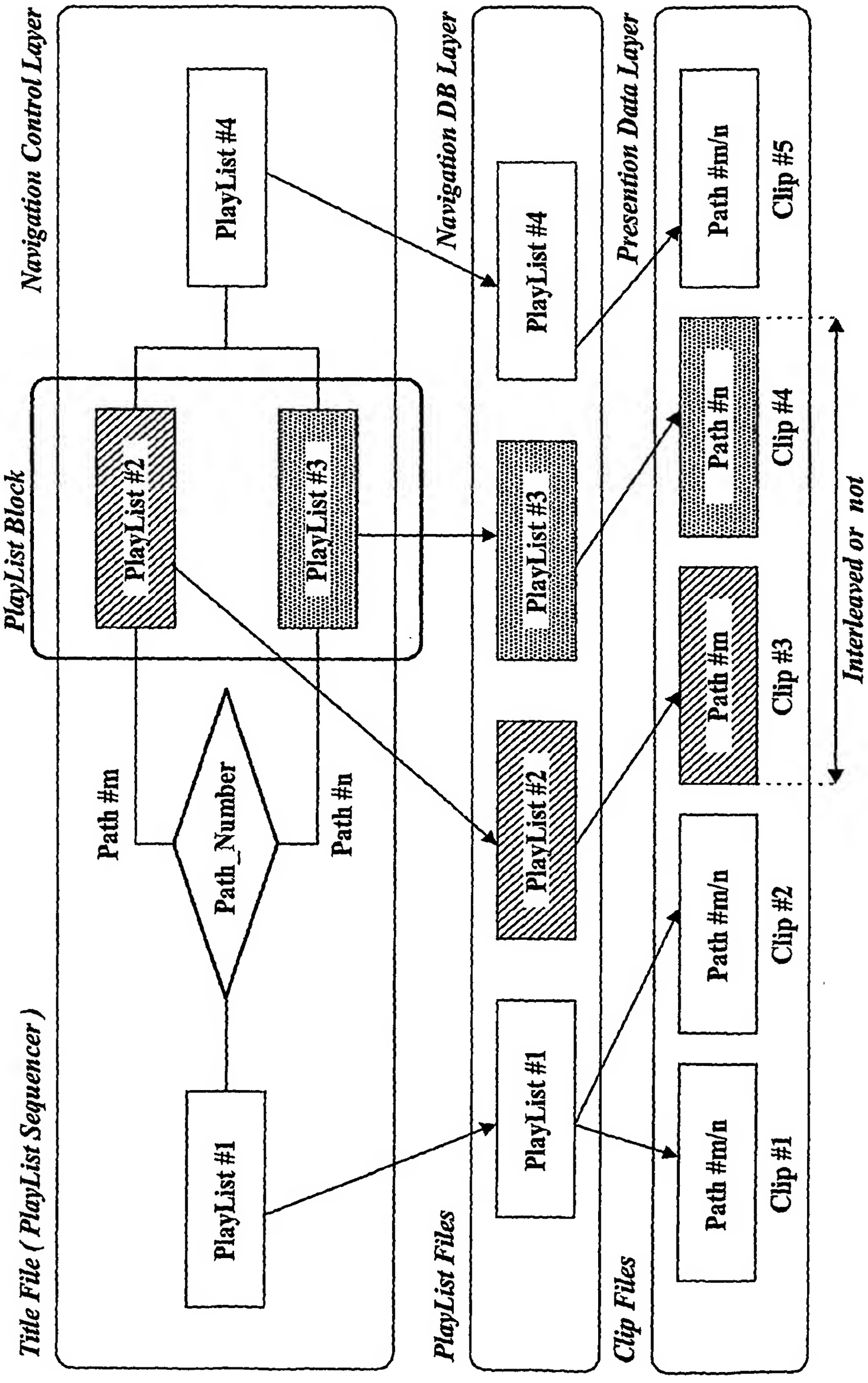

Navigation Control Layer
Navigation DB Layer
Presention Data Layer
PlayList #4
PlayList Block
PlayList #2
PlayList #3
Path #m
Path #n
Path_Number
PlayList #1
PlayList #4
PlayList #3
PlayList #2
PlayList #1
Path #m/n
Path #n
Path #m
Path #m/n
Path #m/n
Clip #5
Clip #4
Clip #3
Clip #2
Clip #1
Interleaved or not
Title File (PlayList Sequencer)
PlayList Files
Clip Files

FIG. 13

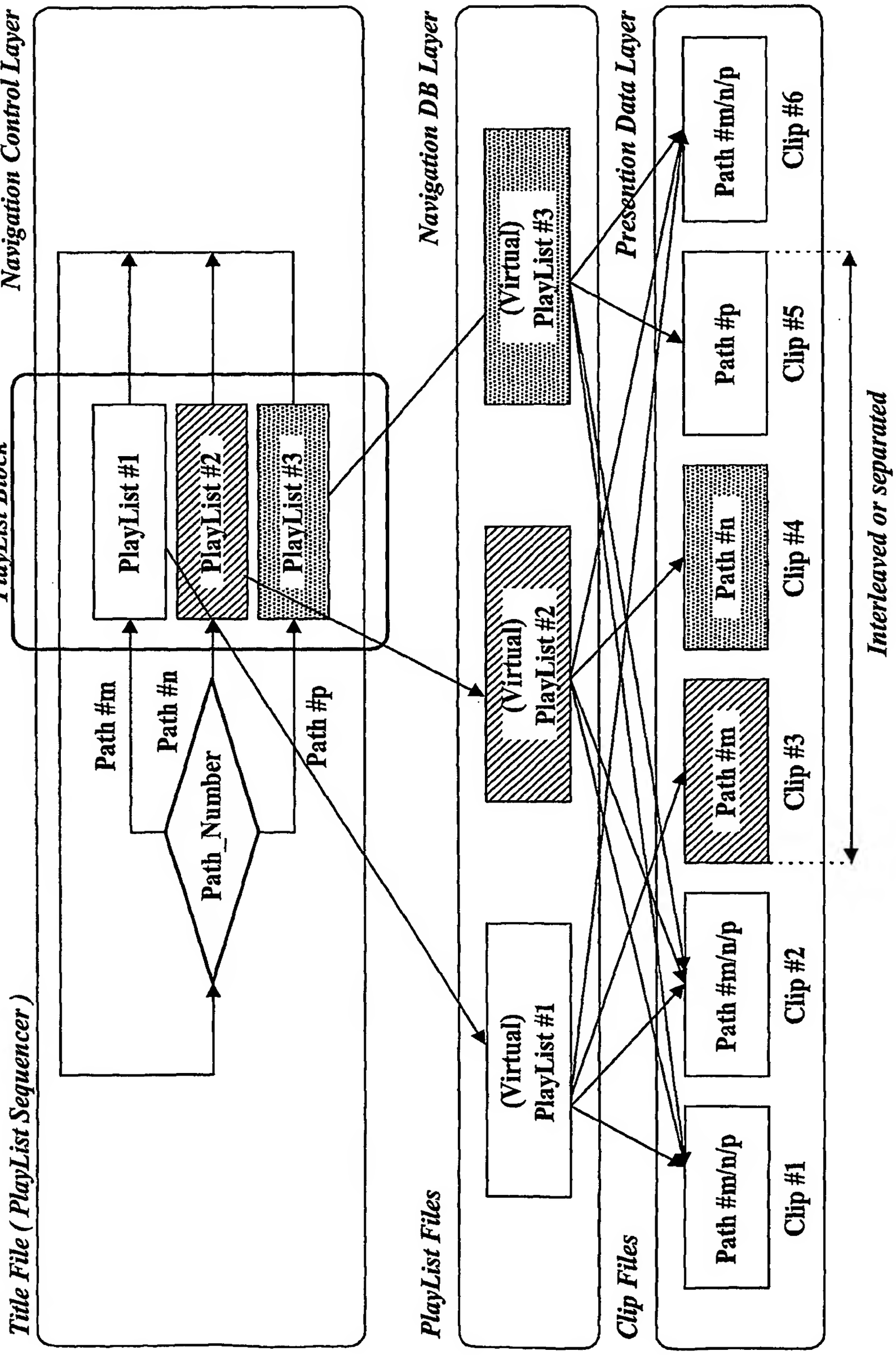

Title File (PlayList Sequencer)
Navigation Control Layer
PlayList Block
PlayList #1
PlayList #2
PlayList #3
Path #m
Path #n
Path #p
Path_Number
Navigation DB Layer
PlayList Files
(Virtual) PlayList #1
(Virtual) PlayList #2
(Virtual) PlayList #3
Presentation Data Layer
Clip Files
Path #m/n/p
Path #n
Path #p
Path #m
Clip #1
Clip #2
Clip #3
Clip #4
Clip #5
Clip #6
Interleaved or separated

FIG. 14

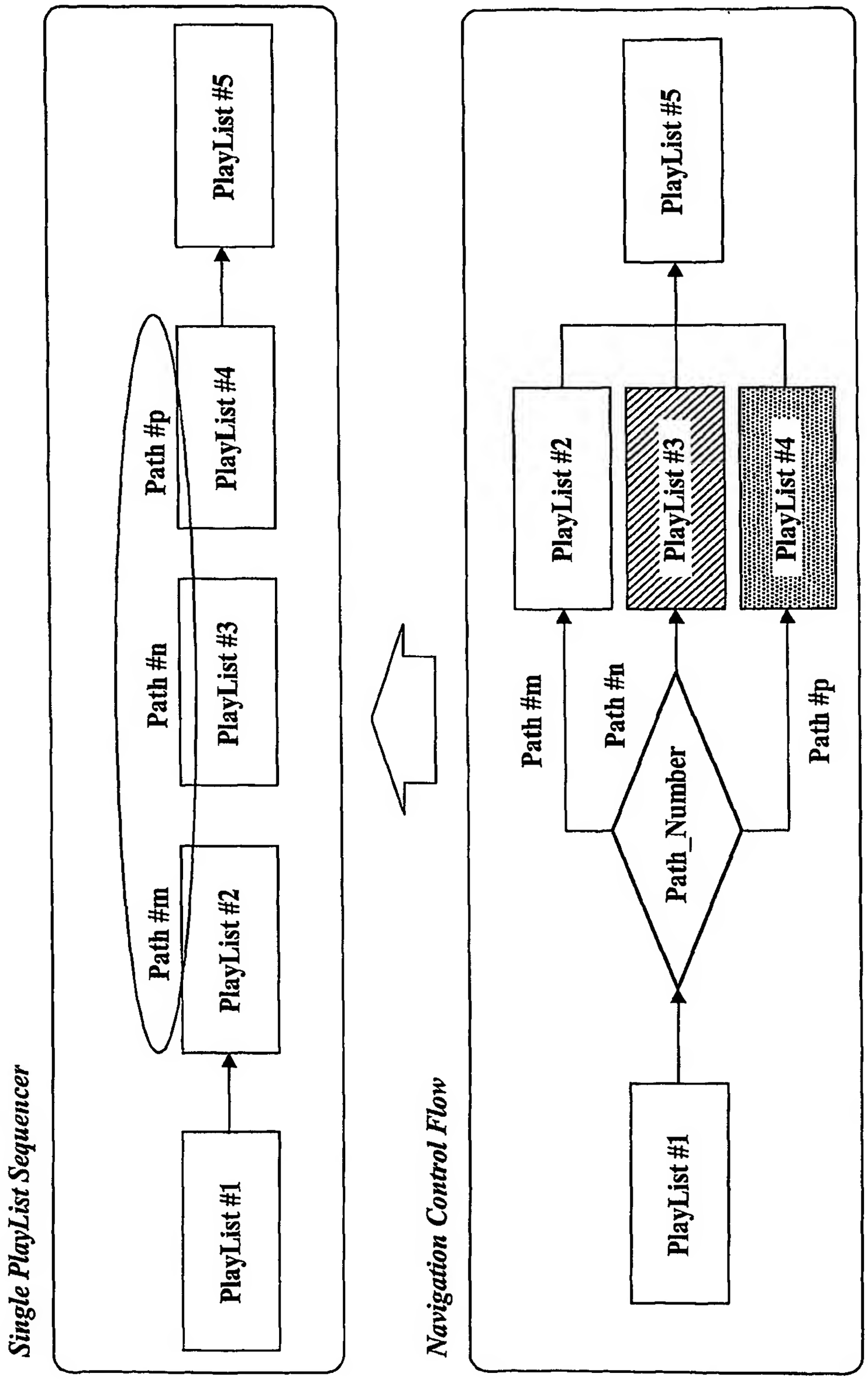
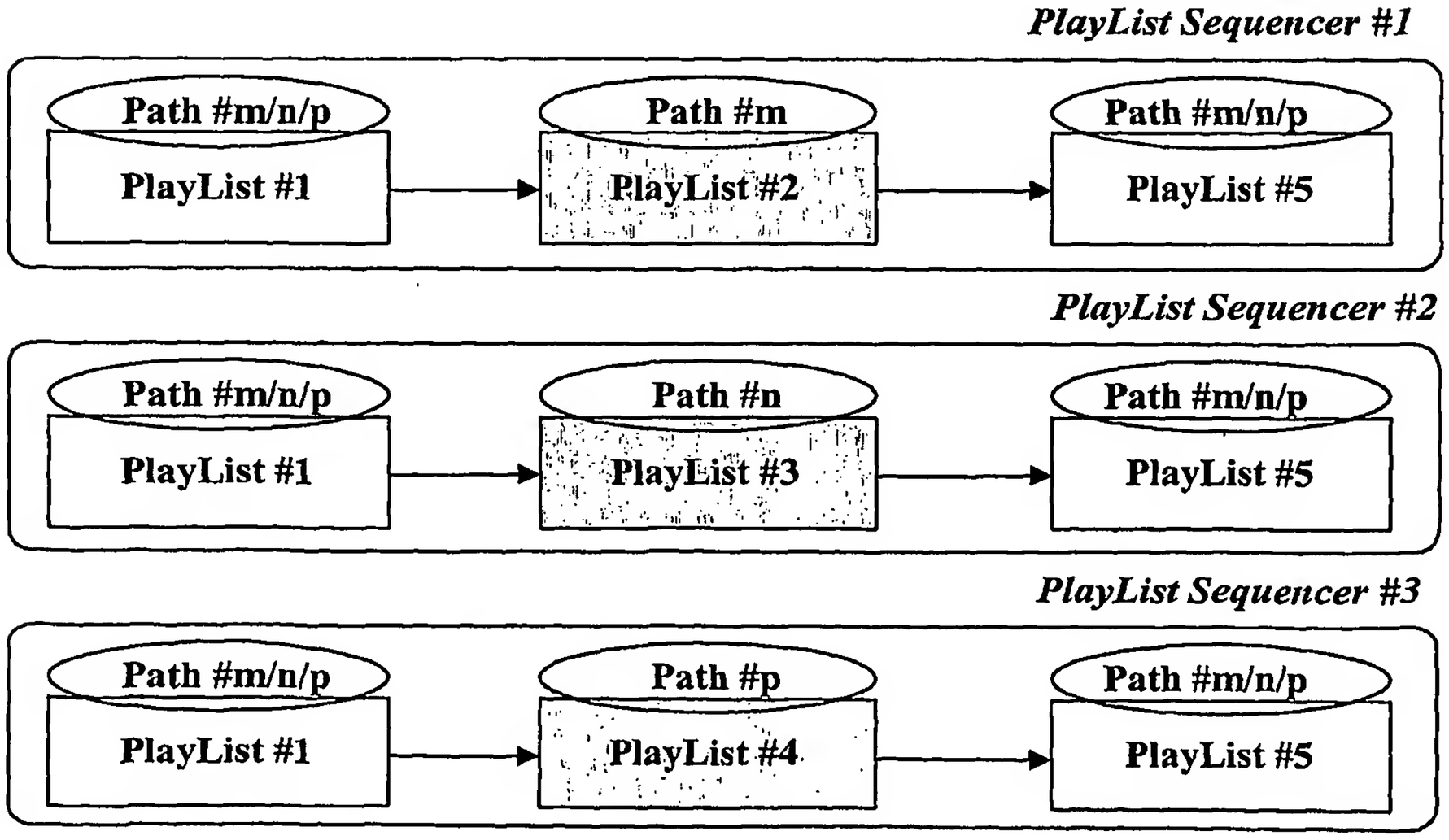

Single PlayList Sequencer
PlayList #1
PlayList #2
Path #m
PlayList #3
Path #n
PlayList #4
Path #p
Navigation Control Flow
PlayList #1
Path_Number
PlayList #2
Path #m
PlayList #3
Path #n
PlayList #4
Path #p

FIG. 15

One of Multiple PlayList Sequencers

```
PlayList_Sequencer () {
        Length
        Type
        Path_number
        Number_of_PlayLists
        for (I=0; j<number_of_PlayLists; j++) {
                PlayList_file_name
                Property
        }
}
```

FIG. 16



INTERNATIONAL SEARCH REPORT

	International application No. PCT/KR03/01148

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G11B 20/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 G11B 20/10 G11B 27/00 G11B 20/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975
Korean Utility models and applications for utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2001-169246 A (SHARP) 22 JUNE 2001 See the whole documents (Family None)	1-14
A	EP 1126454 A1 (MATSUSHITA) 22 AUGUST 2001 See the whole document & WO 01/04893, KR 2001-0085765 A	1-14
A	JP 2000-235779 A (NEC) 29 AUGUST 2000 See the whole document (Family None)	1-14
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(54) Title: RECORDING MEDIUM HAVING DATA STRUCTURE FOR MANAGING REPRODUCTION OF MULTIPLE REPRODUCTION PATH VIDEO DATA FOR AT LEAST A SEGMENT OF A TITLE RECORDED THEREON AND RECORDING AND REPRODUCING METHODS AND APPARATUSES

(57) Abstract: The recording medium includes at least one data area storing more than one clip of video data for at least one segment of a title, and each clip of video data is associated with a different reproduction path of the segment.

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DESCRIPTION

RECORDING MEDIUM HAVING DATA STRUCTURE FOR MANAGING REPRODUCTION OF MULTIPLE REPRODUCTION PATH VIDEO DATA FOR AT LEAST A SEGMENT OF A TITLE RECORDED THEREON AND RECORDING AND REPRODUCING METHODS AND APPARATUSES

1. TECHNICAL FIELD

The present invention relates to a recording medium having a data structure for managing reproduction of at least multiple reproduction path video data recorded thereon as well as methods and apparatuses for reproduction and recording.

2. BACKGROUND ART

The standardization of new high-density read only and rewritable optical disks capable of recording large amounts of high-quality video and audio data has been progressing rapidly and new optical disk related products are expected to be commercially available on the market in the near future. The Blu-ray Disc Rewritable (BD-RW) is one example of these new optical disks.

Fig. 1 illustrates the file structure of the BD-RW. The file structure or data structure provides for managing the reproduction of the video and audio data recorded on the BD-RW. As shown, the data structure includes a root directory that contains at least one BDAV directory. The BDAV directory includes files such as 'info.bdav', 'menu.tidx', and 'mark.tidx', a PLAYLIST subdirectory in which playlist files (*.rpls and *.vpls) are stored, a CLIPINF subdirectory in which clip information files (*.clpi) are stored, and a STREAM subdirectory in which MPEG2-formatted A/V stream clip files (*.m2ts) corresponding to the clip information files are stored. In addition to illustrating the data structure

of the optical disk, Fig. 1 represents the areas of the optical disk. For example, the general information file info.bdav is stored in a general information area or areas on the optical disk.

Because the BD-RW data structure and disk format as illustrated in Fig. 1 is well-known and readily available, only a brief overview of the file structure will be provided in this disclosure.

As alluded to above, the STREAM directory includes MPEG2-formatted A/V stream files called clips. The STREAM directory may also include a special type of clip referred to as a bridge-clip A/V stream file. A bridge-clip is used for making seamless connection between two or more presentation intervals selected in the clips, and generally have a small data size compared to the clips. The A/V stream includes source packets of video and audio data. For example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet number, which is generally a sequentially assigned number that serves as an address for accessing the source packet. Transport packets include a packet identifier (PID). The PID identifies the sequence of transport packets to which a transport packet belongs. Each transport packet in the sequence will have the same PID.

The CLIPINF directory includes a clip information file associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence information, program information and timing information. The sequence information describes the arrival time basis (ATC) and system time basis (STC) sequences. For example, the sequence information indicates, among other things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and the PID of the transport packets in each sequence. A sequence of source packets in which the contents of a program is constant

is called a program sequence. The program information indicates, among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

The timing information is referred to as characteristic point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number).

The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of editing/assembling clips for playback. A playlist file is a collection of playing intervals in the clips. Each playing interval is referred to as a playitem. The playlist file, among other things, identifies each playitem forming the playlist, and each playitem, among other things, is a pair of IN-point and OUT-point that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies playitems, each playitem points to a clip or portion thereof and identifies the clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

A playlist directory may include real playlists (*.rpls) and virtual playlists (*.vpls). A real playlist can only use clips and not bridge-clips. Namely, the real playlist is considered as referring to parts of clips, and therefore, conceptually considered equivalent in disk space to the referred to parts of the clips. A virtual playlist can use both clips and bridge-clips, and therefore, the conceptual considerations of a real playlist do not exist with virtual playlists.

The info.bdav file is a general information file that provides general information for managing the reproduction of the A/V stream recorded on the optical disk. More specifically, the

info.bdav file includes, among other things, a table of playlists that identifies the files names of the playlist in the PLAYLIST directory of the same BDAV directory.

The menu.tidx, menu.tdt1 and menu.tdt2 files store information related to menu thumbnails. The mark.tidx, mark.tdt1 and mark.tdt2 files store information that relates to mark thumbnails. Because these files are not particularly relevant to the present invention, they will not be discussed further.

The standardization for high-density read-only optical disks such as the Blu-ray ROM (BD-ROM) is still under way. An effective data structure for managing reproduction of video and audio data recorded on the high-density read-only optical disk such as a BD-ROM is not yet available.

3. DISCLOSURE OF INVENTION

The recording medium according to the present invention includes a data structure for managing reproduction of at least multiple reproduction path video data recorded on the recording medium.

According to one exemplary embodiment, the recording medium includes at least one data area storing more than one clip of video data for at least one segment of a title, and each clip of video data is associated with a different reproduction path of the segment. For example, in one embodiment, each reproduction path is a different camera angle for the segment.

According to another exemplary embodiment of the present invention, the recording medium further includes a clip information directory area having at least one entry point map associated with each reproduction path in the segment. Each entry point map identifies the video data for the associated reproduction path and identifies a presentation time of the identified video data. In this exemplary embodiment, the entry point maps may be aligned in time.

According to still another exemplary embodiment of the present invention, the recording medium further includes a clip information directory area having a single entry point map identifying at least the video data in the segment. The entry point map identifies a presentation time of the identified video data.

According to a further exemplary embodiment of the present invention, the recording medium further includes a path management area storing path management information. The path management information identifies clips of video data associated with each reproduction path of at least the segment.

According to a still further exemplary embodiment, the recording medium includes at least one data area storing video data packets for at least one segment of a title. The video data packets are associated with different reproduction paths for the segment and the video data packets associated with each reproduction path for the segment are recorded as one group. In the data area the recorded groups are multiplexed.

The present invention further provides apparatuses and methods for recording and reproducing the data structure according to the present invention.

4. BRIEF DESCRIPTION OF DRAWINGS

The above features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 illustrates the prior art file or data structure of a rewritable optical disk according to the Blu-ray Disc Rewritable (BD-RW) standard;

Fig. 2 illustrates an exemplary embodiment of a recording medium file or data structure according to the present invention;

Fig. 3 illustrates an example of a recording medium having the data structure of Fig. 2 stored thereon;

Fig. 4A illustrate a first detailed embodiment of the clip files, disk data and EP map for use in the data structure according to Fig. 2;

Fig. 4B illustrates the time alignment that exists between the EP maps for the different clip files;

Figs. 5 and 6 illustrate first and second embodiments of the data structure for reproduction path management information for use in the data structure according to Fig. 2;

Fig. 7 illustrates a schematic diagram of an embodiment of an optical disk recording and reproduction apparatus of the present invention; and

Fig. 8 illustrates a second detailed embodiment of the clip files, disk data and EP map for use in the data structure according to Fig. 2.

5. MODES FOR CARRYING OUT THE INVENTION

In order that the invention may be fully understood, preferred embodiments thereof will now be described with reference to the accompanying drawings.

A high-density optical disk, for example, a Blu-Ray ROM (BD-ROM) in accordance with the invention may have a file or data structure for managing reproduction of video and audio data as shown in Fig. 2. Many aspects of the data structure according to the present invention shown in Fig. 2 are similar to that of the BD-RW standard discussed with respect to Fig 1. As such these aspects will not be described in great detail.

As shown in Fig. 2, the root directory contains at least one DVP directory. The DVP directory includes a general information file info.dvp, menu files menu.tidx, menu.tdt1 among others, a PLAYLIST directory in which playlist files (e.g., real (*.rpls) and virtual (*.vpls)) are stored, a CLIPINF directory in which clip information files (*.clpi) are stored, and a STREAM directory in which MPEG2-formatted A/V stream clip files (*.m2ts),

corresponding to the clip information files, are stored.

The STREAM directory includes MPEG2-formatted A/V stream files called clips. The STREAM directory may also include a special type of clip referred to as a bridge-clip A/V stream file. A bridge-clip is used for making seamless connection between two or more presentation intervals selected in the clips, and generally have a small data size compared to the clips. The A/V stream includes source packets of video and audio data. For example, a source packet of video data includes a header and a transport packet. A source packet includes a source packet number, which is generally a sequentially assigned number that serves as an address for accessing the source packet. Transport packets include a packet identifier (PID). The PID identifies the sequence of transport packets to which a transport packet belongs. Each transport packet in the sequence will have the same PID.

The CLIPINF directory includes a clip information file associated with each A/V stream file. The clip information file indicates, among other things, the type of A/V stream associated therewith, sequence information, program information and timing information. The sequence information describes the arrival time basis (ATC) and system time basis (STC) sequences. For example, the sequence information indicates, among other things, the number of sequences, the beginning and ending time information for each sequence, the address of the first source packet in each sequence and the PID of the transport packets in each sequence. A sequence of source packets in which the contents of a program is constant is called a program sequence. The program information indicates, among other things, the number of program sequences, the starting address for each program sequence, and the PID(s) of transport packets in a program sequence.

The timing information is referred to as characteristic point information (CPI). One form of CPI is the entry point (EP) map. The EP map maps a presentation time stamp (e.g., on an arrival time

basis (ATC) and/or a system time basis (STC)) to a source packet address (i.e., source packet number).

The PLAYLIST directory includes one or more playlist files. The concept of a playlist has been introduced to promote ease of editing/assembling clips for playback. A playlist file is a collection of playing intervals in the clips. Each playing interval is referred to as a playitem. The playlist file, among other things, identifies each playitem forming the playlist, and each playitem, among other things, is a pair of IN-point and OUT-point that point to positions on a time axis of the clip (e.g., presentation time stamps on an ATC or STC basis). Expressed another way, the playlist file identifies playitems, each playitem points to a clip or portion thereof and identifies the clip information file associated with the clip. The clip information file is used, among other things, to map the playitems to the clip of source packets.

A playlist directory may include real playlists (*.rpls) and virtual playlists (*.vpls). A real playlist can only use clips and not bridge-clips. Namely, the real playlist is considered as referring to parts of clips, and therefore, conceptually considered equivalent in disk space to the referred to parts of the clips. A virtual playlist can use both clips and bridge-clips, and therefore, the conceptual considerations of a real playlist do not exist with virtual playlists.

The info.dvp file is a general information file that provides general information for managing the reproduction of the A/V streams recorded on the optical disk. More specifically, the info.dvp file includes, among other things, a table of playlists that identifies the file names of the playlists in the PLAYLIST directory. The info.dvp file will be discussed in greater detail below with respect to the embodiments of the present invention.

In addition to illustrating the data structure of the recording medium according to an embodiment of the present invention, Fig. 2 represents the areas of the recording medium.

For example, the general information file is recorded in one or more general information areas, the playlist directory is recorded in one or more playlist directory areas, each playlist in a playlist directory is recorded in one or more playlist areas of the recording medium, etc. Fig. 3 illustrates an example of a recording medium having the data structure of Fig. 2 stored thereon. As shown, the recording medium includes a file system information area, a data base area and an A/V stream area. The data base area includes a general information file and playlist information area and a clip information area. The general information file and playlist information area have the general information file recorded in a general information file area thereof, and the PLAYLIST directory and playlist files recorded in a playlist information area thereof. The clip information area has the CLIPINFO directory and associated clip information files recorded therein. The A/V stream area has the A/V streams for the various titles recorded therein.

Video and audio data are typically organized as individual titles; for example, different movies represented by the video and audio data are organized as different titles. Furthermore, a title may be organized into individual chapters in much the same way a book is often organized into chapters.

Because of the large storage capacity of the newer, high-density recording media such as BD-ROM optical disks, different titles, various versions of a title or portions of a title may be recorded, and therefore, reproduced from the recording media. For example, video data representing different camera angles may be recorded on the recording medium. As another example, versions of title or portions thereof associated with different languages may be recorded on the recording medium. As a still further example, a director's version and a theatrical version of a title may be recorded on the recording medium. Or, an adult version, young adult version and young child version (i.e., different parental control versions) of a title or portions of a title may be recorded on the

recording medium. Each version represents a different reproduction path, and the video data in these instances is referred to as multiple reproduction path video data. It will be appreciated that the above examples of multiple reproduction path video data are not limiting, and the present invention is applicable to any type or combination of types of multiple reproduction path video data. As will be described in detail below with respect to embodiments of the present invention, the data structures according to the present invention include path management information and/or navigation information for managing reproduction of multiple reproduction path video data recorded on the recording medium.

A multiple reproduction path data stream, for instance, a multi-story, a multi-parental-level, or a multi-angle data stream recorded as a title in a physical data recording area of a recording medium (e.g., a BD-ROM) may be managed as a plurality of clip files. For example, clip files 1-3 shown in FIG. 4A correspond to a title and the A/V streams recorded in the clip files are in the form of MPEG2-formatted transport packets (TPs).

The TPs of the multi-path data stream contain packet IDs (PIDs) unique to each of the paths (e.g., different camera angles) for identifying the path. The TPs (TP1) of clip file 1 corresponding to path 1 include the information that Video_PID=A and Audio_PID=P and the TPs (TP2) of clip file 2 corresponding to path 2 include the information that Video_PID=B and Audio_PID=R. Likewise, the TPs (TP3) of clip file 3 corresponding to path 3 include the information that Video_PID=C and Audio_PID=S.

The TPs of the clip files 1, 2, and 3 corresponding to paths 1, 2, and 3 respectively are recorded in the AV stream area within the physical data recording area of, for example, the BD-ROM in an interleaved manner. The TPs for the multiple reproduction paths are interleaved on a PID basis as interleave blocks, each of which contains at least one I-picture. And, the first transport packet

of each interleave block is the first transport packet of an I-picture.

Clip information files 1, 2, and 3 corresponding to clip files 1, 2, and 3, respectively include search information for selectively accessing TPs of each reproduction path. For example, as shown in Fig. 4A, each clip information file includes one or more entry point (EP) maps containing the presentation time stamps (PTSs) mapping to source packet numbers (SPNs) of the TPs in an associated clip file. In one exemplary embodiment, a one-to-one relationship exists between the EP maps and the number of paths included in the multiple reproduction path data stream. In the example of FIG. 4A, three EP maps 1, 2, 3 corresponding to the clip files 1, 2, and 3, respectively, are created and recorded in the corresponding clip information files 1, 2, and 3.

Fig. 4B illustrates the time alignment that exists between the EP maps for the different clip files. As discussed, an EP map maps the presentation time stamp information such as indicated in a playitem to a source packet. More particularly, the presentation time stamp is mapped to the address or identifier of the source packet. The address or identifier is the source packet number (SPN). Fig. 4B further shows the source packets by source packet number along the presentation time stamp axis for each clip file 1, 2, and 3. As shown, source packets in each of the EP maps 1, 2, and 3 have the same presentation time stamps. For example, source packet x1 from the first clip file 1, source packet y1 from the second clip file 2 and source packet z1 from the third clip file 3 have the same presentation time stamp T1. As such, the EP maps 1, 2 and 3 are time-aligned. Because of this time-alignment, seamless reproduction of video data is possible even when the reproduction path is changed during reproduction. Fig. 4B illustrates changes in reproduction path by two concentric circles. As shown, if a user decides to change the reproduction path from clip file 2 to clip file 1 during reproduction of source packet

y2, then after completing reproduction of source packet y2, source packet x3 is the next source packet reproduced. Similarly if a user decides to change reproduction path (e.g., change camera angle to view) from clip file 1 to clip file 3 during reproduction of source packet x4, then after completing reproduction of source packet x4, source packet z5 is reproduced. It will be understood that the source packet numbers given in the example above are merely exemplary, and that a source packet in one clip file will not, generally, have the same source packet number as a time aligned source packet in another clip file.

Fig. 5 illustrates a portion of the general information file info.dvp according to an embodiment of the present invention. As shown, the general information file info.dvp includes an information field called 'TableOfPlaylists'. The playlist table 'TableOfPlaylists' indicates the length of the information field, and the number of playlists in the PLAYLIST directory. For each playlist, the playlist table 'TableOfPlaylists' indicates the file name 'PlayList_file_name' of the playlist (which identifies the playlist) and a path number 'Path_number'. The path number 'Path_number' provides path management information by indicating the path or paths to which the associated playlist belongs. In the embodiment of Figs. 4A-4B, one clip corresponds to each path. Accordingly, each playlist file includes one playitem, which points to the one clip associated with the same path as the playlist file. It should be understood, however, that the present invention is not limited to this structure.

In another exemplary embodiment of the present invention, the playlist table 'TableOfPlaylists' does not include path management information. In this embodiment, illustrated in Fig. 6, the path management information is provided in the playlist files. As shown, each playlist file indicates a length of the file, and the number of playitems 'number_of_PlayItems' forming the playlist. For each playitem, a playitem information field is provided in the playlist

file. Here, each playitem is identified by the number of the playitem. As shown in Fig. 6, the playitem information field includes, in part, an indication of the field's length and a path number 'Path_number'. The path number 'Path_number' provides the path management information by indicating the path to which the associated playitem belongs.

Fig. 7 illustrates a schematic diagram of an embodiment of an optical disk recording and reproducing apparatus according to the present invention. As shown, an AV encoder 9 receives and encodes audio and video data. The AV encoder 9 outputs the encoded audio and video data along with coding information and stream attribute information. A multiplexer 8 multiplexes the encoded audio and video data based on the coding information and stream attribute information to create, for example, an MPEG-2 transport stream. A source packetizer 7 packetizes the transport packets from the multiplexer 8 into source packets in accordance with the audio/video format of the optical disk. As shown in Fig. 7, the operations of the AV encoder 9, the multiplexer 8 and the source packetizer 7 are controlled by a controller 10. The controller 10 receives user input on the recording operation, and provides control information to AV encoder 9, multiplexer 8 and the source packetizer 7. For example, the controller 10 instructs the AV encoder 9 on the type of encoding to perform, instructs the multiplexer 8 on the transport stream to create, and instructs the source packetizer 7 on the source packet format. The controller 10 further controls a drive 3 to record the output from the source packetizer 7 on the optical disk.

The controller 10 also creates the path management information for managing reproduction of the audio/video data being recorded on the optical disk. For example, based on information received via the user interface (e.g., instruction set saved on disk, provided over an intranet or internet by a computer system, etc.) the controller 10 controls the drive 3 to record the

data structure of Figs. 2, 4 and 5 or 6 on the optical disk.

During reproduction, the controller 10 controls the drive 3 to reproduce this data structure. Based on the information contained therein, as well as user input received over the user interface (e.g., control buttons on the recording and reproducing apparatus or a remote associated with the apparatus), the controller 10 controls the drive 3 to reproduce the audio/video source packets from the optical disk. For example, the user input may specify a path to reproduce. This user input may be specified, for example, via a menu based graphical user interface preprogrammed into the controller 10. Using the user input and the path management information reproduced from the optical disk, the controller 10 controls the reproduction of the specified path.

For example, to select a particular path, the path numbers for each playlist are examined by the controller 10 to determine the number of reproduction paths, and the user is requested which path to reproduce. The path management information may be augmented to provide more meaningful information regarding the reproduction path to reproduce. During reproduction, the EP map for the selected path is accessed to perform reproduction. And, as discussed above, if the user changes the reproduction path during reproduction, a seamless change takes place by using the EP map of the new reproduction path that is aligned in time with the EP map of the old reproduction path.

The reproduced source packets are received by a source depacketizer 4 and converted into a data stream (e.g., an MPEG-2 transport packet stream). A demultiplexer 5 demultiplexes the data stream into encoded video and audio data. An AV decoder 6 decodes the encoded video and audio data to produce the original audio and video data that was feed to the AV encoder 9. During reproduction, the controller 10 controls the operation of the source depacketizer 4, demultiplexer 5 and AV decoder 6. The controller 10 receives user input on the reproducing operation, and provides control

information to AV decoder 6, demultiplexer 5 and the source packetizer 4. For example, the controller 10 instructs the AV decoder 9 on the type of decoding to perform, instructs the demultiplexer 5 on the transport stream to demultiplex, and instructs the source depacketizer 4 on the source packet format.

While Fig. 7 has been described as a recording and reproducing apparatus, it will be understood that only a recording or only a reproducing apparatus may be provided using those portions of Fig. 7 providing the recording or reproducing function.

Fig. 8 illustrates a second detailed embodiment of the clip files, disk data and EP map for use in the data structure according to Fig. 2. As explained before, a multi-path data stream recorded in a physical data recording area, for example, of the BD-ROM may be managed as a plurality of clip files. For example, clip files 1-3 shown in FIG. 8 correspond to a title and the A/V streams recorded in the clip files are in the form of MPEG2-formatted transport packets (TPs).

The TPs (TP1) of clip file 1 corresponding to Path 1 include the information that Video_PID=A and Audio_PID=P and the TPs (TP2) of clip file 2 corresponding to Path 2 include the information that Video_PID=B and Audio_PID=R. Likewise, the TPs (TP3) of clip file 3 corresponding to Path 3 include the information that Video_PID=C and Audio_PID=S. The TPs of the clip files 1, 2, and 3 corresponding to Paths 1, 2, and 3 respectively are recorded in the AV stream area within the physical data recording area of the recording medium (e.g., BD-ROM) in an interleaved manner. As mentioned before, the different paths may, in one exemplary embodiment be different camera angles.

The TPs for multiple reproduction paths are interleaved as interleave blocks each of which contains at least one I-picture. And the first transport packet of each interleave block is the first transport packet of an I-picture.

The path management information for playback control of the

single-path and multi-path A/V streams recorded as a single title in the physical data recording area of the BD-ROM may be recorded in a clip information file corresponding to the clip files, as depicted in FIG. 8.

For example, the path management information is recorded and managed as path sequence information in a clip information file corresponding to the clip files 1, 2, and 3. The path sequence information includes the path sequence numbers (Path_Sequence Numbers) corresponding to the recording segments, for example, recording segments 1, 2, and 3 and video/audio PIDs (Video_PIDs and Audio_PIDs).

In more detail, Path_Sequence #1, corresponding to a first recording segment, includes the information that 'Video_PID=A' and 'Audio_PID=P', which indicates that this recording segment only includes video data for the first reproduction path. Path_Sequence #2, corresponding to the second recording segment, includes the information that 'Video_PID =A,B,C' and 'Audio_PID=P,R,S', which indicates that this segment of video data includes video data for the first, the second, and the third reproduction paths. Path_Sequence #3, corresponding to a third recording segment, includes the information that 'Video_PID =C' and 'Audio_PID=S', which indicates that the video data in this recording segment includes video data for only the third reproduction path.

Each path sequence also includes a source packet number SPN for each reproduction path in the path sequence. The SPN for a reproduction path is the first source packet for that reproduction path in that path sequence.

A path sequence may correspond to video data segment having one or more of the reproduction paths included therein. Also, the number of path sequences is not limited to three.

In addition to the path sequence information, Fig. 8 shows that the clip information files for the clip files 1, 2, and 3,

provide the same search information for selectively accessing TPs of each path recorded in the first through third segments. For example, the same EP map is provided by clip information files. When the EP map information recorded in the clip information files is managed as a single EP map, the PTSs and SPNs of TPs of the different reproduction paths are recorded in the EP map by interleaving in the same order that the TPs of the different reproduction paths are recorded.

Alternatively, as shown with respect to Figs. 4A and 4B, a one-to-one correspondence may exist between EP maps and reproduction paths. In the case of Fig. 8, three EP maps (EP_map 1, 2, 3) corresponding to the groups of TPs of paths 1, 2, 3 respectively would be created and recorded in the clip information file.

As will be readily apparent, the recording and reproducing apparatus of Fig 7 may operate in the same manner with respect to the embodiment of Fig. 8 as was described above with respect to Figs. 4A and 4B. However, it will be appreciated that other methods of reproduction are also possible and the present invention is not limited to this one example. For instance, path management information in the form of the path sequence information in the clip information files may be reproduced and used to manage the reproduction of multiple reproduction path video data. Here, the PIDs in each path sequence are examined to determine the number of reproduction paths. The user is then requested to select a path. If a single EP map is provided, the controller 10 uses the EP map and the PID of the selected path to reproduce the appropriate clip file for the selected reproduction path. If an EP map for each reproduction path is provided, then the EP map corresponding to the selected reproduction path is used to reproduce the clip file for the selected reproduction path. And, as discussed above, if the user changes the reproduction path during reproduction, a seamless change takes place by using the EP map of the new

reproduction path that is aligned in time with the EP map of the old reproduction path.

As will be appreciated from the forgoing disclosure, the present invention provides a recording medium having a file or data structure that permits managing the reproduction of video data on a multiple reproduction path basis. Accordingly, the present invention provides a greater level of flexibility in the reproduction of video data than previously available.

While the invention has been disclosed with respect to a limited number of embodiments, those skilled in the art, having the benefit of this disclosure, will appreciate numerous modifications and variations there from. For example, while described with respect to a Blu-ray ROM optical disk in several instances, the present invention is not limited to this standard of optical disk or to optical disks. It is intended that all such modifications and variations fall within the spirit and scope of the invention.

CLAIMS

1. A recording medium having a data structure for managing reproduction of at least multiple reproduction path video data recorded on the recording medium, comprising:

at least one data area storing more than one clip of video data for at least one segment of a title, each clip of video data associated with a different reproduction path of the segment.

2. The recording medium of claim 1, wherein each reproduction path is a different camera angle for the segment.

3. The recording medium of claim 1, further comprising:

a clip information directory area including at least one entry point map associated with each reproduction path in the segment, each entry point map identifying the video data for the associated reproduction path and identifying a presentation time of the identified video data.

4. The recording medium of claim 3, wherein the entry point maps are aligned in time.

5. The recording medium of claim 3, wherein

the video data are recorded as video data packets and each video data packet has a packet number that differentiates one video data packet from another; and

the entry point map identifies the video data in the segment by identifying the packet numbers of the video data packets.

6. The recording medium of claim 1, further comprising:

a clip information directory area including a single entry point map identifying at least the video data in the segment, the entry point map identifying a presentation time of the identified video data.

7. The recording medium of claim 6, wherein

the video data are recorded as video data packets and each

video data packet has a packet number that differentiates one video data packet from another; and

the entry point map identifies the video data in the segment by identifying the packet numbers of the video data packets.

8. The recording medium of claim 1, wherein

the video data are recorded as video data packets and at least a portion of the video data packets associated with different reproduction paths for the segment are interleaved.

9. The recording medium of claim 8, wherein

the video data packets associated with each reproduction path for the segment are recorded as one group, and the groups are interleaved.

10. The recording medium of claim 8, wherein

the video data packets associated with each reproduction path for the segment are recorded as one or mores groups, at least one reproduction path having more than one group, and the groups are interleaved.

11. The recording medium of claim 10, wherein each group of video data packets represents at least an intra-coded picture.

12. The recording medium of claim 11, wherein a first video data packet in each group is a start of an intra-coded picture.

13. The recording medium of claim 1, further comprising:

a path management area storing path management information, the path management information identifying clips of video data associated with each reproduction path of at least the segment.

14. A recording medium having a data structure for managing reproduction of at least multiple reproduction path video data recorded on the recording medium, comprising:

at least one data area storing video data packets for at least one segment of a title, the video data packets being associated with different reproduction paths for the segment and the video data packets associated with each reproduction path for the segment being recorded as one group, and the groups being interleaved.

15. A method of recording a data structure for managing reproduction of at least multiple reproduction path video data on a recording medium, comprising:

recording more than one clip of video data for at least one segment of a title in at least one data area, each clip of video data associated with a different reproduction path of the segment.

16. A method of reproducing a data structure for managing reproduction of at least multiple reproduction path video data recorded on a recording medium, comprising:

reproducing at least one clip of video data for at least one segment of a title from at least one data area, the data area including more than one clip of video data and each clip associated with a different reproduction path of the segment.

17. An apparatus for recording a data structure for managing reproduction of at least multiple reproduction path video data on a recording medium, comprising:

a driver for driving an optical recording device to record data on the recording medium;

an encoder for encoding at least multiple reproduction path video data; and

a controller for controlling the driver to record more than one clip of video data for at least one segment of a title in at least one data area, each clip of video data associated with a different reproduction path of the segment.

18. An apparatus for reproducing a data structure for managing reproduction of at least multiple reproduction path video data recorded on a recording medium, comprising:

a driver for driving an optical reproducing device to reproduce data recorded on the recording medium;

a controller for controlling the driver to reproduce at least one clip of video data for at least one segment of a title from at least one data area, the data area including more than one clip of video data and each clip associated with a different

reproduction path of the segment.

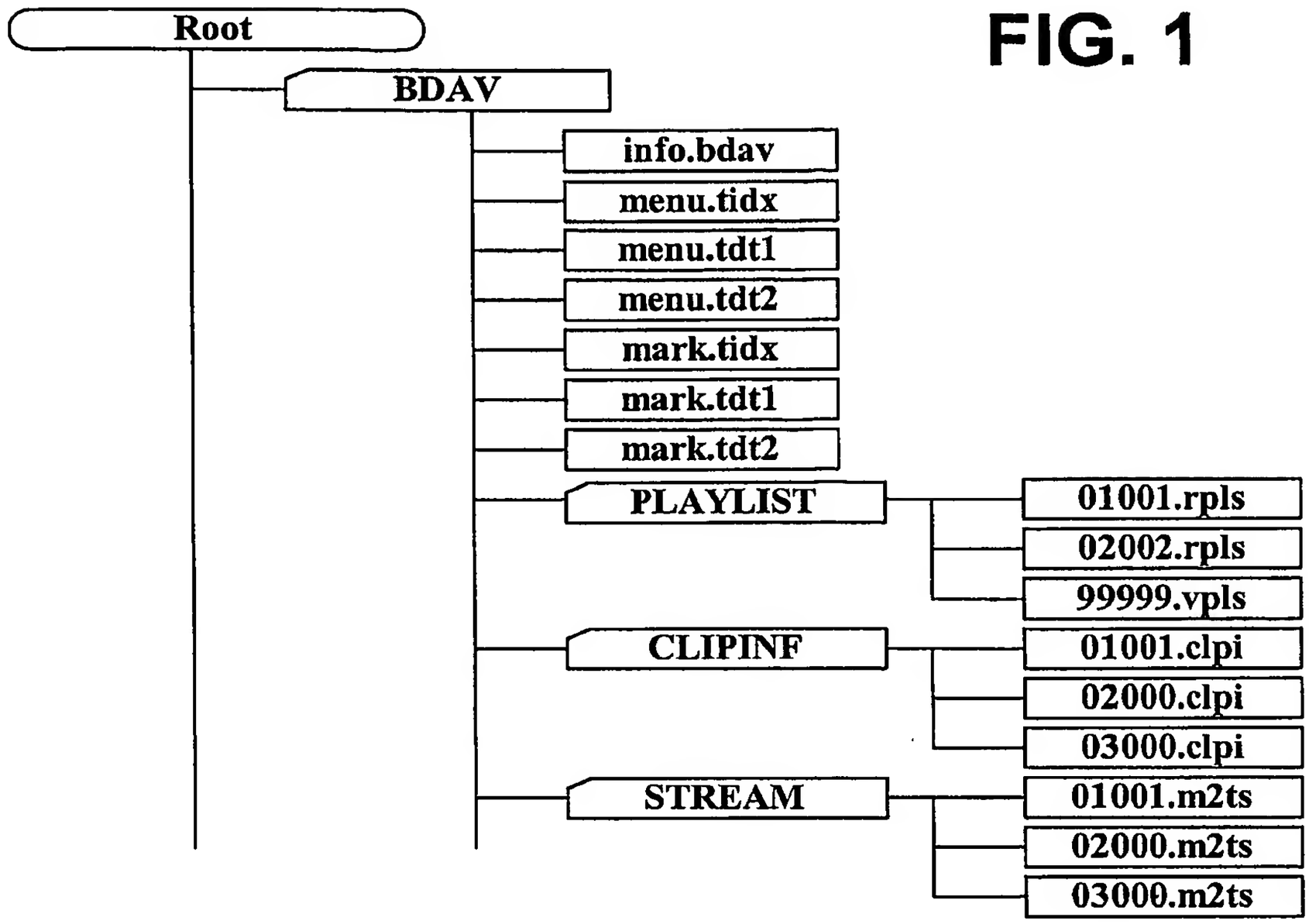

Root
BDAV
info.bdav
menu.tidx
menu.tdt1
menu.tdt2
mark.tidx
mark.tdt1
mark.tdt2
PLAYLIST
01001.rpls
02002.rpls
99999.vpls
CLIPINF
01001.clpi
02000.clpi
03000.clpi
STREAM
01001.m2ts
02000.m2ts
03000.m2ts

FIG. 1

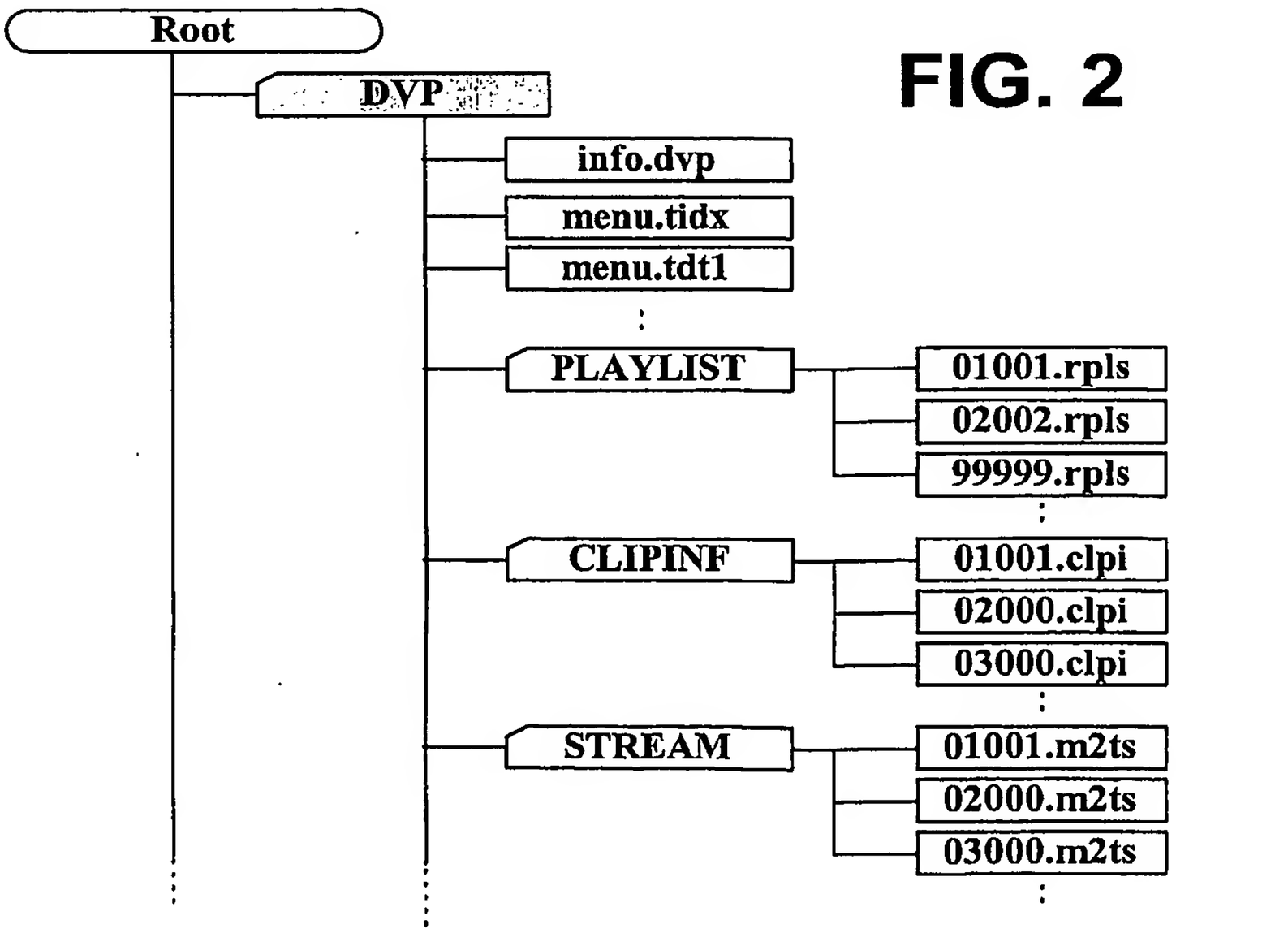

Root
DVP
info.dvp
menu.tidx
menu.tdt1
PLAYLIST
01001.rpls
02002.rpls
99999.rpls
CLIPINF
01001.clpi
02000.clpi
03000.clpi
STREAM
01001.m2ts
02000.m2ts
03000.m2ts

FIG. 2

FIG. 3

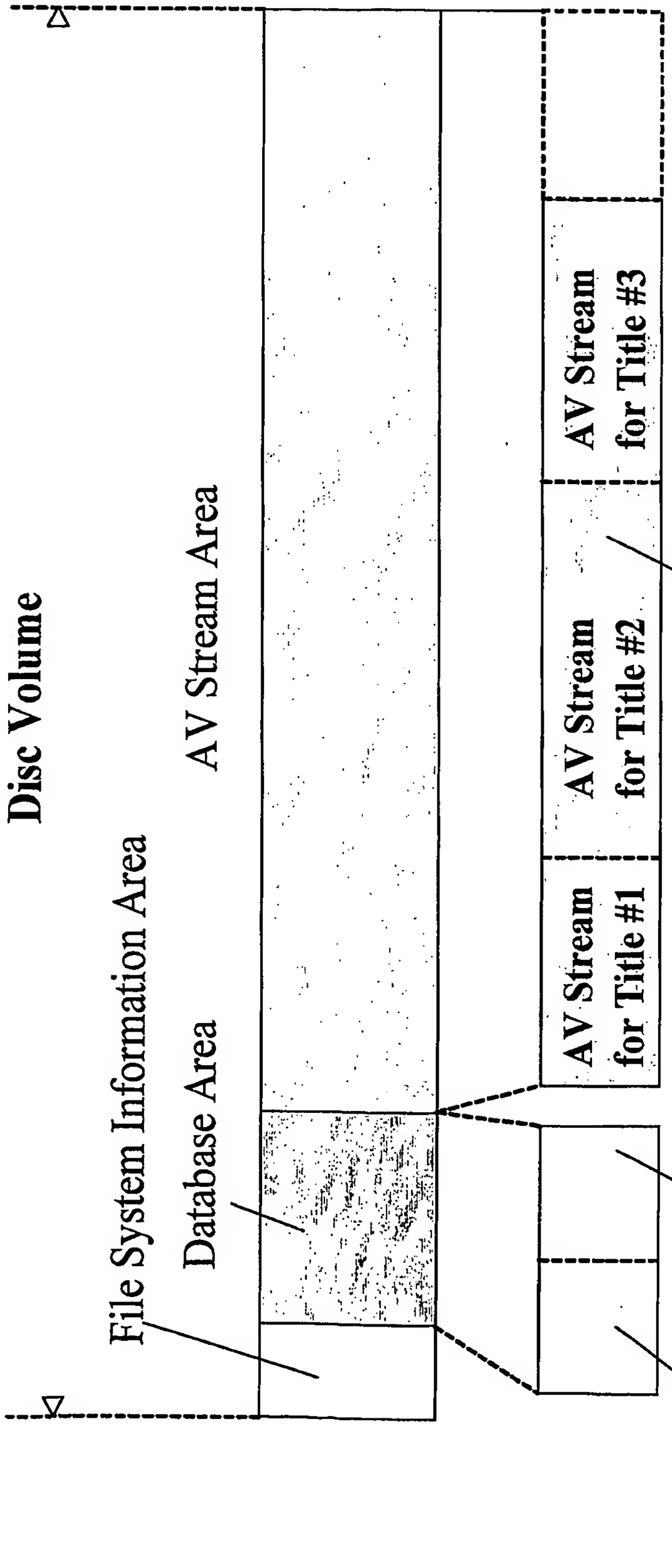

Disc Volume
File System Information Area
Database Area
AV Stream Area
AV Stream for Title #1
AV Stream for Title #2
AV Stream for Title #3
AV stream data (*.m2ts)
Info.dvp & PlayList Information Area (*.rpls, *.vpls)
Clip Information Area (*.clpi)

FIG. 4A

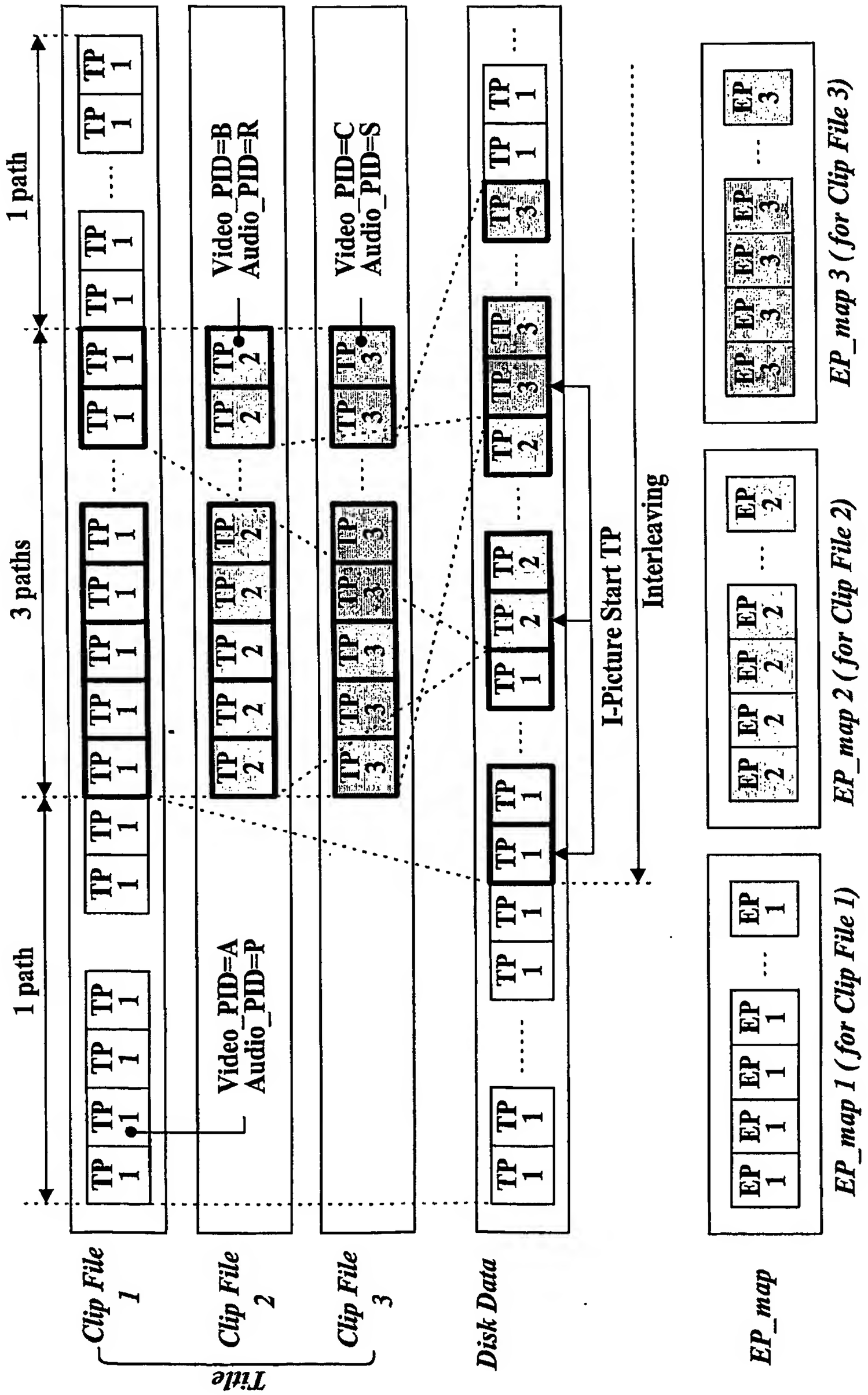

Title
Clip File 1
Clip File 2
Clip File 3
Disk Data
EP_map
1 path
3 paths
1 path
Video_PID=A
Audio_PID=P
Video_PID=B
Audio_PID=R
Video_PID=C
Audio_PID=S
I-Picture Start TP
Interleaving
EP_map 1 (for Clip File 1)
EP_map 2 (for Clip File 2)
EP_map 3 (for Clip File 3)

FIG. 4B

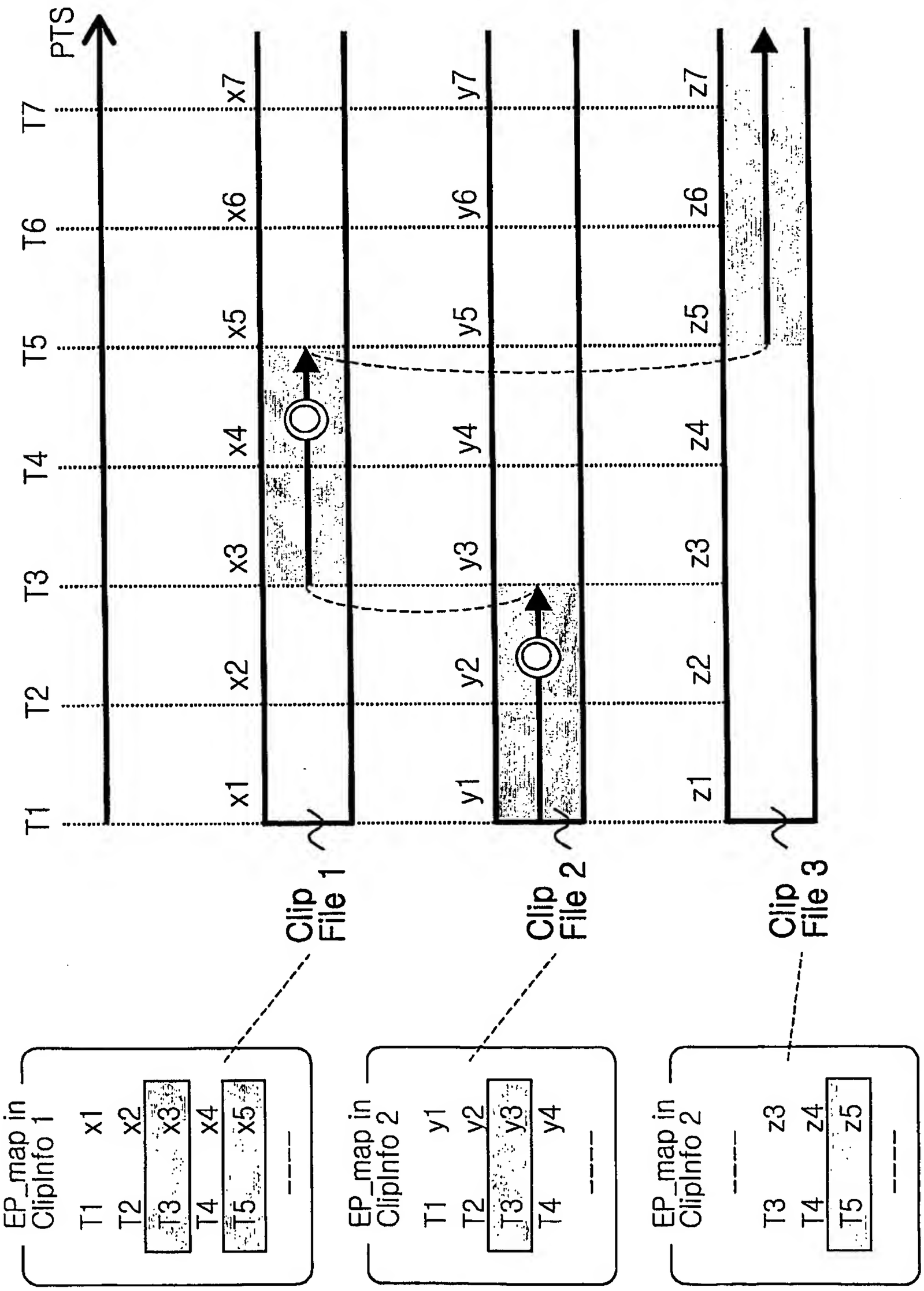

PTS
T1
T2
T3
T4
T5
T6
T7
x1
x2
x3
x4
x5
x6
x7
y1
y2
y3
y4
y5
y6
y7
z1
z2
z3
z4
z5
Clip File 1
Clip File 2
Clip File 3
EP_map in ClipInfo 1
T1 x1
T2 x2
T3 x3
T4 x4
T5 x5
EP_map in ClipInfo 2
T1 y1
T2 y2
T3 y3
T4 y4
EP_map in ClipInfo 2
T3 z3
T4 z4
T5 z5

FIG. 5

info.dvp - syntax

info.dvp {
version_number
TableOfPlayLists_start_address
reserved_for_future_use
⋮
TableOfPlayLists(){
length
number_of_PlayLists
for(I=0; i<number_of_PlayLists; i++){
PlayList_file_name
path_number
.....
}
}
⋮

FIG. 6

**.rpls - syntax*

xxxxx.rpls {
version_number
.....
PlayList(){
length
.....
number_of_PlayItems
for(i=0; i<number_of_Playitems; i++){
PlayItem()
⋮

PlayItem(){
length
.....
path_number
.....

FIG. 7

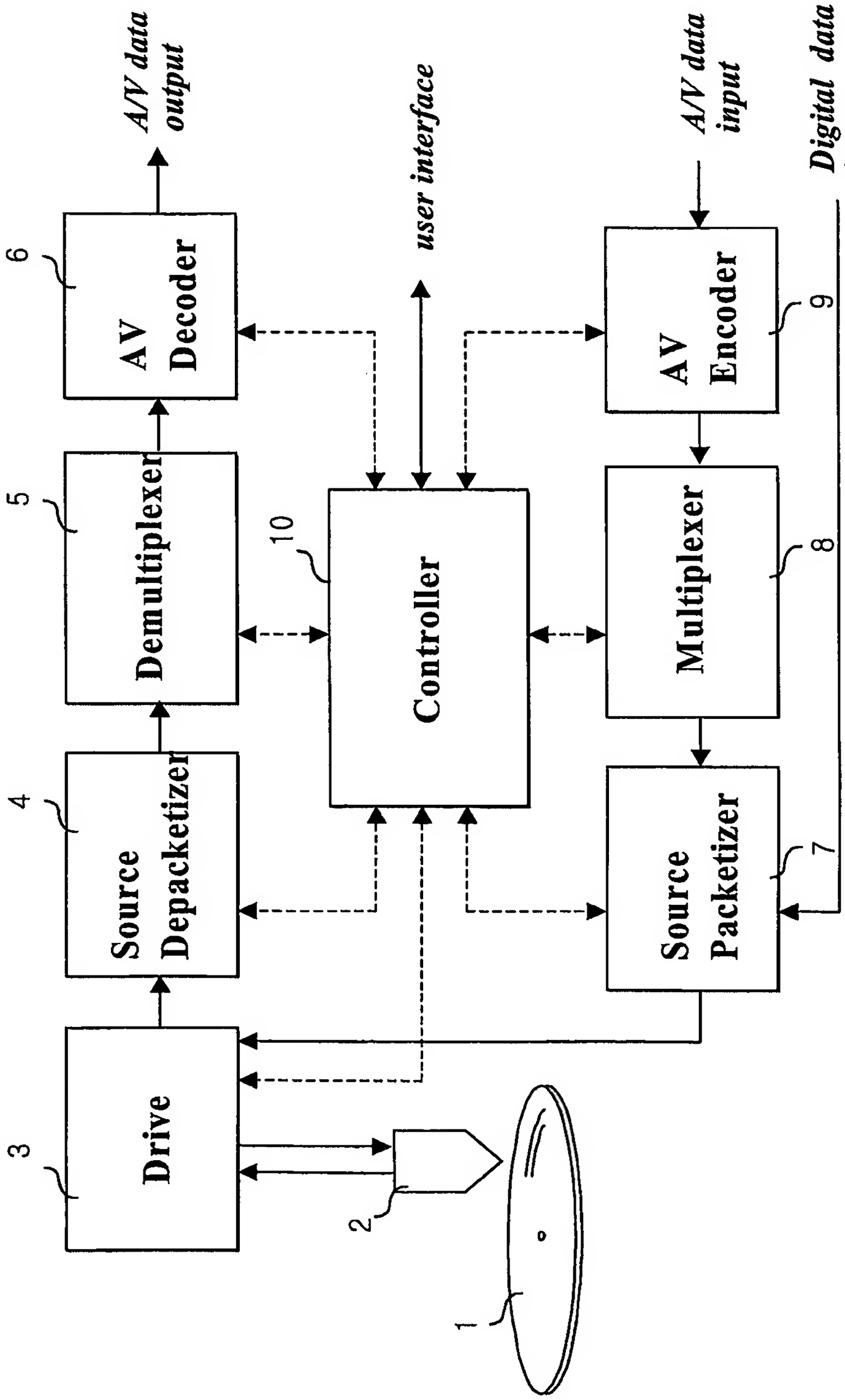
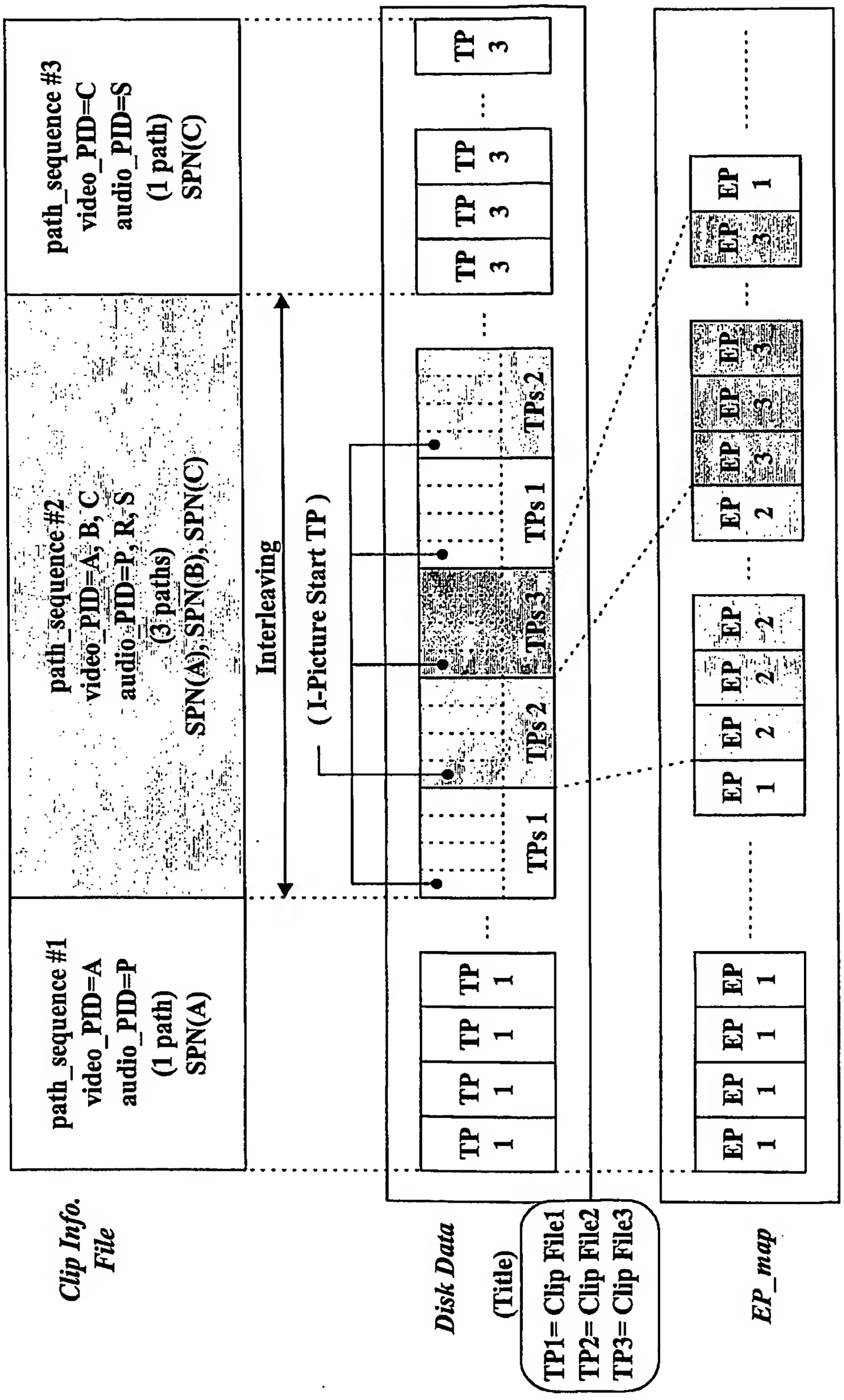

A/V data output
A/V data input
Digital data input
user interface
AV Decoder
AV Encoder
Demultiplexer
Controller
Multiplexer
Source Depacketizer
Source Packetizer
Drive
6
5
10
9
8
4
7
3
2
1

FIG. 8


path_sequence #3
video_PID=C
audio_PID=S
(1 path)
SPN(C)
path_sequence #2
video_PID=A, B, C
audio_PID=P, R, S
(3 paths)
SPN(A), SPN(B), SPN(C)
path_sequence #1
video_PID=A
audio_PID=P
(1 path)
SPN(A)
Interleaving
(I-Picture Start TP)
TP 3
TPs 1
TPs 2
TPs 3
EP 1
EP 2
EP 3
Clip Info. File
Disk Data
(Title)
TP1= Clip File1
TP2= Clip File2
TP3= Clip File3
EP_map

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR03/01199

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 G11B 20/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC G11B 20/10 G11B 20/12 G11B 27/00 G11B 27/32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Patents and applications for since 1975
Korean Utility models and applications for utility models since 1975

Electronic data base consulted during the internationl search (name of data base and, where practicable, search terms used)
"structure,manag*,multiple, reproduc*, path, data, medium,clip,directory"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2002-150685A(SAMSUNG) 24 MAY 2002 See the whole document	1~18
A	JP 2001-169246A(SHARP) 22 JUNE 2001 See the whole document	1~18
A	JP 2000-235779A(NEC) 29 AUGUST 2000 See the whole document	!~18
A	EP 1126454A1(MATSUSHITA) 22 AUGUST 2001 See the whole document	1~18
A	KR 2002-0020919A(SONY) 16 MARCH 2002 See the whole document	1~18
A	KR 2001-0022702A(MATSUSHITA) 26 MARCH 2001 See the whole document	1~18

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
09 OCTOBER 2003 (09.10.2003)	09 OCTOBER 2003 (09.10.2003)

Name and mailing address of the ISA/KR
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Republic of Korea
Facsimile No. 82-42-472-7140

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Telephone No. 82-42-481-8135

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR03/01199

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2002-150685A(SAMSUNG)	24-5-2002	None	
JP 2001-169246A(SHARP)	22-6-2001	None	
JP 2000-235779A(NEC)	29-8-2000	None	
EP 1126454A1(MATSUSHITA)	22-8-2001	WO 01/04893 A1	18-01-2001
KR 2002-0020919A(SONY)	16-3-2002	None	
KR 2001-0022702A(MATSUSHITA)	26-3-2001	None	